

Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:

Marthias, Tiara Wariana

Title:

Assessing the magnitude and factors contributing to socioeconomic and geographical inequalities in maternal and child health care utilisation in Indonesia

Date:

2020

Persistent Link:

<https://hdl.handle.net/11343/274698>

Terms and Conditions:

Terms and Conditions: Copyright in works deposited in Minerva Access is retained by the copyright owner. The work may not be altered without permission from the copyright owner. Readers may only download, print and save electronic copies of whole works for their own personal non-commercial use. Any use that exceeds these limits requires permission from the copyright owner. Attribution is essential when quoting or paraphrasing from these works.

Assessing the magnitude and factors contributing to socioeconomic and geographical inequalities in maternal and child health care utilisation in Indonesia

Tiara W. Marthias

ORCID ID: 0000-0001-8226-9473

Doctor of Philosophy in Public Health

October 2020

School of Population and Global Health

Faculty of Medicine, Dentistry and Health Sciences

Submitted in total fulfillment for the degree of

Doctor of Philosophy in Public Health at the University of Melbourne, Australia

Abstract

Significant progress has been made in reducing maternal and child mortality at the global level. However, the burden of maternal and child mortality remains high. Indonesia, home to over 270 million population, has one of the highest burden of maternal and child mortality in the world. One of the main challenges in reducing maternal and child health burden in Indonesia, and other LMICs, is inequitable access to essential maternal and child health (MCH) interventions, particularly among the poorest population and those living in remote areas with poor access to health services. It is crucial to understand the influence of health systems on MCH to inform the design and implementation of health interventions. Furthermore, there is also limited evidence on the impact of health insurance on effective MCH service coverage, disparities of health care, and health outcomes. The four objectives in this thesis addressed these issues.

First, I described the geographical inequalities in skilled birth attendance (SBA) coverage across Indonesia regions and quantified the contributions of socioeconomic and health supply-side factors towards the geographical variations. Geographical inequality in SBA coverage was mainly driven by disparities in the availability of health supply-side, i.e. the number of skilled birth attendants and hospitals. Interestingly, the number of primary health centres did not influence the uptake of SBA.

Second, I assessed the trends and inequalities in the RMCH effective coverage from 2002-2017 to examine gaps in the RMCH care cascade, and investigate variations of these cascade indicators among regions and socio-demographic groups over time. The study revealed that while significant improvement has been made in the levels of crude coverage for all MCH services, the quality of care is still low. The user adherence in following the standards of antenatal care and childhood immunisation was also found to be a challenge. Antenatal care and maternal delivery services were the least equitable interventions compared to family planning and childhood immunisation services. Provinces with similar levels of overall coverage had varying degrees of inequity. This indicates different pathways towards high coverage in relation to the distribution of the services.

Next, I evaluated the association of the Indonesia national health insurance (JKN program), the largest single-payer health insurance program in the world, on access to maternal health service and child mortality. Findings from my thesis clearly indicated that JKN was associated with increased coverage of antenatal care, SBA and facility-based delivery. However, JKN was not associated with the reduction in neonatal or infant mortality. This study supports WHO call for universal health coverage through the expansion of social health insurance in LMICs. Quality improvement initiatives must place greater emphasis on the vulnerable population, less developed regions, and geographically remote areas. Finally, the JKN influenced women's choice of the type of birth attendant and place of delivery. JKN could reduce unsafe deliveries by increasing the SBA use and facility-based deliveries. However, JKN also promoted the use of high-level maternal care, particularly among the

richer population and women living in more developed regions in Indonesia. Hence, the main lesson from this study for the healthcare system in Indonesia and other countries is that health insurance coverage by itself may not be sufficient to address challenges in the quality and appropriateness of care. Consequently, future health system reform must place greater emphasis on strengthening integrated primary health care to achieve universal health coverage in Indonesia.

Declaration

Assessing the magnitude and factors contributing to socioeconomic and geographical inequalities in maternal and child health care utilisation in Indonesia

I, Tiara Wariana Marthias, declare that:

- (i) the thesis comprises only my original work towards the PhD except where indicated in the preface;
- (ii) due acknowledgement has been made in the text to all other material used; and
- (iii) the thesis is fewer than the maximum word limit in length, exclusive of tables, maps, bibliographies.

Signed

Tiara W. Marthias

Date: 22 October 2020

Preface

This thesis takes the form of a 'PhD with publications', comprising four journal articles that present the research results, as well as six standard chapters including an introduction, overviews of the maternal and child health burden and the Indonesian health systems, literature review, methods chapter, discussion and conclusion.

The publication status of the journal articles included in this thesis are as follows:

Manuscript 1

Marthias, T., McPake, B., Palmer, M. "Explaining geographical inequality in maternal health care utilisation in Indonesia: a decomposition analysis," submitted to *International Journal for Equity in Health* on 3 October 2020 (Chapter 6).

Manuscript 2

Marthias, T., McPake, B., Morgan, A., Carvalho, N., Putri, PP, Emilia, O., Lee, JT. "Distributional pathways towards universal effective coverage for RMCH services in Indonesia, 2002-2017," submitted to *BMJ Global Health* on 23 October 2020 (Chapter 7).

Manuscript 3

Marthias, T., McPake, B., Carvalho, N., Millett, C., Anindya, K., Saputri, NS., Trisnantoro, L., Lee, JT. "Associations between national health insurance and maternal health service use, neonatal and infant mortality in Indonesia: an interrupted time-series analysis," submitted to *Journal of Epidemiology and Community Health* on 10 August 2020 (Chapter 8).

Manuscript 4

Marthias, T., McPake, B., Putri, LP, Anindya, K., Puspendari, DA, L., Lee, JT. "The synergistic effect of insurance coverage, socioeconomic status and geographical region in women's choice in birth attendant and place of delivery in Indonesia: a multinomial logit analysis," submitted to *Journal of Global Health* on 22 October 2020 (Chapter 8).

The manuscripts in this thesis were developed through collaboration between my co-authors and myself. Under the guidance of my supervisors, I developed the research objectives, conducted the literature reviews, performed all data management and statistical analyses, and wrote the first drafts for all manuscripts. My contribution to each article was 70% for the first manuscript and 80% for manuscript 2, 3 and 4.

Prof. Barbara McPake is the Director of the Nossal Institute for Global Health at the University of Melbourne. As my primary PhD supervisor, Prof. McPake provided supervision and advice throughout all aspects of study development and design and the preparation of the journal articles and thesis chapters. Prof. McPake provided substantive guidance and considerable inputs on each of the manuscript, contributed to the interpretation of findings and critically reviewed all manuscripts.

Dr. Michael Palmer was my PhD co-supervisor and is now a Senior Lecturer in the Department of Economics at the University of Western Australia. Dr. Palmer advised on methodological and substantive aspects, contributed to the interpretation of findings and provided constructive feedback on Manuscript 1.

Dr. Natalie Carvalho was my PhD co-supervisor and is a Senior Research Fellow at the Centre for Health Policy & Global Burden of Disease Group at the University of Melbourne. Dr. Carvalho also provided substantive and methodological guidance on Manuscript 2 and 3 and critically reviewed the multiple drafts of the manuscripts.

Dr. John Tayu Lee was also my PhD co-supervisor and is a Senior Lecturer at Nossal Institute for Global at the University of Melbourne. Dr. Lee advised on methodological and substantive aspects for Manuscript 2, 3 and 4 and also critically reviewed the manuscripts.

Associate Professor Dr. Alison Morgan, PhD is a maternal health specialist, formerly the Head of Maternal, Sexual and Reproductive Unit at the Nossal Institute for Global Health. Dr. Morgan advised on the effective framework that was used in Manuscript 2 and critically reviewed the manuscript.

Prof. Christopher Millett, PhD is a public health specialist with a research interest in public health policy evaluation. Prof. Millett provided substantive inputs for the policy implications section in Manuscript 3 and critically reviewed the drafts.

Dr. Likke Prawidya Putri is a lecturer at the University of Gadjah Mada and specialising in rural health. Dr. Putri provided substantive inputs at the protocol design stage and critically reviewed Manuscript 2 and 4.

Kanya Anindya, MPH is a collaborator at the Nossal Institute for Global Health and is a public health statistician. Ms Anindya provided substantive input at the protocol design stage and feedback on Manuscript 2 and 4.

Nurmala Selly Saputri, MPH is a public health researcher at the SMeRU Research Institute in Indonesia and provided substantive input during the writing stage and critically reviewed Manuscript 2.

Dr. Diah Ayu Puspadari is a senior lecturer at the Health Policy & Management Department and the University of Gadjah Mada and assisted me in obtaining access to the Indonesia Socioeconomic Survey (Susenas) and provided contextual and substantive feedback on the fourth manuscript.

Prof. Ova Emila is a maternal health specialist and is the Dean of the Faculty of Medicine, Public Health and Nursing at the Gadjah Mada University in Indonesia. Dr. Emilia provided contextual and substantive feedback on the second manuscript.

Prof. Laksono Trisnantoro is a health policy and management specialist and is the Head of Health Policy & Management Department and the University of Gadjah Mada. Dr. Trisnantoro provided contextual feedback and advised on the policy implications section on the third manuscript.

My PhD candidature has been generously supported by The Australia Awards Scholarship (2016-2020, Department of Defence and Foreign Trade, Australian Government).

Acknowledgements

My PhD journey started four years ago. After four and a half years of working at the Universitas Gadjah Mada in Indonesia, I had the feeling that I do not know enough about a lot of things, and research is one of them. So I reached out to Dr. Krishna Hort whom I had the pleasure of working with during my MPH years at the University of Melbourne. He instantly said that Prof. Barbara McPake has just recently been appointed as the director of the Nossal Institute and he straightaway connected me to the person whose writings were used extensively as mandatory readings during my MPH years. That was a big thrill for me. And I was very fortunate to be awarded funding from the DFAT-Australia Awards Scholarship that allowed me to pursue a PhD degree.

I want to thank Prof. Barbara McPake for her support during the last 4 years of my study. Every meeting with her has provided me not only growth in understanding of the health system but also about career, professional relationships, and life in general. I also would like to acknowledge Dr. John Tayu Lee, who did not only took me in as his student but also provided a strong and generous mentorship during these last few years. Having Dr. Lee as my co-supervisor was a life-saving decision. To Dr. Natalie Carvalho, I also express my gratitude for her meticulousness in providing methodological input and guidance during the writing process of the manuscripts. Dr. Michael Palmer has provided his guidance in the earlier years of my PhD and from him, I learned about respect, tolerance, and how to be a good collaborator in academia.

I also would like to acknowledge the health workers in rural Papua, who have taught me so much about the challenges they are facing on a daily basis in trying to deliver the best health care possible for the community. I learned that what is good on paper, such as the evidence-based planning and budgeting for health services initiatives, will not work in regions as challenging as Papua. My travels to Mappi district as a health researcher/consultant for a health planning initiative, for example, ended up as a 12-hour drive in muddy off-road conditions and another 12-hour boat ride along the crocodile-infested waters of the Digoel river. And I would never forget what Dr. Roni, the head of Mappi district health office, asked myself; “Doc, now that you have travelled here, what kind of service delivery model do you think would work for us? How can we vaccinate that one village that is another 6-hours away from here?” I might still not know the answer to that, but I hope this PhD journey has broadened my thinking and understanding of how context is everything in the effort to strengthen our health system.

I would also like to extend my gratitude to Dr. Mubasysyir Hasanbasri, who enticed me into the world of public health almost two decades ago. His lecture on medical sociology back when I was just a naïve medical student was so memorable and mindblowing that I decided to pursue a career in public health.

During my PhD years, I have been fortunate to have had a great network of friends who became my family in Melbourne and have been there for me in many ways. Doni Marmer, Wisnu Putra, Yen Ha, Purba Widnyana, Jack Ganbaatar, and Laura Nevendorff, who allowed me to be myself around them. My PhD cohort (Teralynn, Mbak Dewi, Tianxin, Shuai, and Anteneh), with whom I shared not only the stress of being PhD students but also many other life hacks. My

collaborators and friends, Likke and Kanya, I thank you for the support and for showing me what perseverance is all about. And of course, Sonja Firth, who never forgets to keep checking in on me. I look forward to meeting you in Bali.

I have had the opportunity to do other wonderful things outside of my PhD project and I would like to thank Dr. Maria Karikadis and Megan Tindley for the great times teaching for the Intensive Academic Preparation program at the Faculty of Arts and their friendships over the years. Dr. Helen Jordan and Dr. Matthew Reeves have given me the opportunity to learn how to be a good tutor in the public health program and I have learned a lot from their excellent organisation skills and empathetic approach during our collaboration. Associate Professor Dr. Linda Bennet has also given me the opportunity to contribute in Nossal Institute's COVID-19 online course and other rewarding projects. And worth a second mention, Dr. John Tayu Lee has given me great opportunities in collaborating on numerous research projects and in co-supervising a number of MPH students.

I was also fortunate enough to be part of the Equity Initiative Fellowship for Southeast Asia and China since 2018. The fellowship has exposed me to many great learning and collaboration opportunities. But perhaps more importantly, the fellowship program has given me lifelong friendships with Ana Santos, Khaulah Fadzil, and Sophia Hage. From them, I learned how to be more empathetic and understanding and basically, to try to be a better version of myself. And to Sophia, having the opportunity to know you is one of the greatest things that has ever happened to me. Your patience and understanding have helped me grow so much in these last two years and for that, I am forever indebted.

And to my family, the Rasjid and Marthias clans, thank you for the love and support. My brother, Armand, who is always just a phone call away. Kak Nia, my sister-in-law, who would always remember all the small stuff that made me feel loved. And of course, my mom, who always says that she is proud of her kids. Little did you know that we too are proud of you, Mom. I wish Dad is still with us. I remember how he said as a parent, the things that he wanted to provide for his kids are knowledge and education. I love you, Pap.

I dedicate this thesis to my Mom, Rasjida Rasjid Marthias, who always knew what she wanted: to be a university lecturer. However, back in the 1960s, she did not have the privilege of pursuing higher education and decided to work at an oil company in Sumatra as an Executive Secretary to support her family. But she always had that burning desire to complete her degree and pursue her lifelong dream. And so she did. At age 49, she finished her undergraduate degree and at 56, she got her Masters. She is living her dream and has been teaching at a university in Indonesia for the last 16 years. And now, as a fine-looking woman in her 70s, her eyes are locked on getting herself a PhD. You go, Mom!

I completed the writing of this thesis during the COVID-19 pandemic and the Melbourne city lockdown. The year 2020 has been tough, for me and everyone else. I am thankful for having been alive to experience it and for my colleagues, friends, and families who have helped me in surviving and adapting during these difficult times. And I pray for our sanity and health.

As a final note, alhamdulillah...

Table of contents

ABSTRACT	I
DECLARATION	III
PREFACE	IV
ACKNOWLEDGEMENTS	VII
TABLE OF CONTENTS	IX
LIST OF TABLES	XI
LIST OF FIGURES	XII
LIST OF APPENDICES	XIII
CHAPTER 1: INTRODUCTION	1
1. 1 BACKGROUND	1
1. 2 AIM AND OBJECTIVES	4
1. 3 CONTRIBUTION OF THE THESIS	5
1. 4 ORGANISATION OF THE THESIS	6
CHAPTER 2: MATERNAL AND CHILD HEALTH: GLOBAL AND INDONESIA	8
2.1 MATERNAL HEALTH BURDEN: GLOBAL AND INDONESIA	8
2.2 CAUSES OF MATERNAL DEATHS	11
2.3 CHILD HEALTH BURDEN: GLOBAL AND INDONESIA	15
2.4 CAUSES OF CHILD MORTALITY	18
2.5 INTERVENTIONS TO REDUCE MATERNAL AND CHILD MORTALITY	20
2.6 INEQUALITIES IN MATERNAL AND CHILD MORTALITY IN LMICS	24
2.7 SUMMARY	25
CHAPTER 3: CONTEXT OF INDONESIA	26
3. 1 GEOGRAPHY AND DEMOGRAPHY	26
3. 2 HEALTH STATUS	27
3. 3 THE HEALTH SYSTEM IN INDONESIA	28
3. 4 THE NATIONAL HEALTH INSURANCE PROGRAMME	42
CHAPTER 4: LITERATURE REVIEW	47
4. 1 DEFINITION AND THE MEASUREMENT OF SOCIOECONOMIC HEALTH INEQUALITIES	47
4. 2 SOCIOECONOMIC AND GEOGRAPHIC INEQUALITIES IN MATERNAL AND CHILD HEALTH SERVICE UTILISATION	49
4. 3 FACTORS ASSOCIATED WITH MATERNAL AND CHILD HEALTH CARE UTILISATION	57
4. 4 IMPACT OF HEALTH INSURANCE ON MATERNAL HEALTH CARE UTILISATION	61
CHAPTER 5: OVERVIEW OF DATA SOURCES AND METHODOLOGY	66
5. 1. DATA SOURCES	66
5. 2. MEASUREMENT ISSUES	70
5. 3. ETHICS OF THE STUDY	72
CHAPTER 6: EXPLAINING GEOGRAPHICAL INEQUALITY IN MATERNAL HEALTH CARE IN INDONESIA: A DECOMPOSITION ANALYSIS (MANUSCRIPT 1)	73
CHAPTER 7: DISTRIBUTIONAL PATHWAYS TOWARDS HIGH COVERAGE LEVELS OF REPRODUCTIVE, MATERNAL AND CHILD HEALTH INTERVENTIONS IN INDONESIA, 2002-2017 (MANUSCRIPT 2)	91
CHAPTER 8: THE ASSOCIATION OF THE INDONESIA NATIONAL HEALTH INSURANCE PROGRAM ON MATERNAL HEALTH SERVICE UTILISATION CHILD MORTALITY (MANUSCRIPT 3 & 4)	113
CHAPTER 9: DISCUSSION	152

9. 1. SUMMARY OF MAIN FINDINGS	152
9. 2. STRENGTHS AND LIMITATIONS OF THE STUDIES	155
9. 3. IMPLICATIONS FOR PUBLIC HEALTH POLICY	156
9. 4. RESEARCH ARISING FROM THIS THESIS	168
9. 5. CONCLUSION	169
REFERENCES	170
APPENDIX 1: SUPPLEMENTARY MATERIALS FOR MANUSCRIPT 1	216
APPENDIX 2: SUPPLEMENTARY MATERIALS FOR MANUSCRIPT 2	221
APPENDIX 3: SUPPLEMENTARY MATERIALS FOR MANUSCRIPT 3	252
APPENDIX 4: SUPPLEMENTARY MATERIALS FOR MANUSCRIPT 4	273

List of Tables

TABLE 1. 1 OBJECTIVES OF THE THESIS AND METHODS USED	5
TABLE 2. 1 MATERNAL DEATHS BY WHO REGION AND SELECTED SOUTHEAST ASIA COUNTRIES 2017.....	9
TABLE 2. 2 VARIABILITY IN THE ESTIMATES OF MATERNAL MORTALITY IN INDONESIA 2000-2017	11
TABLE 2. 3 GLOBAL AND REGIONAL CAUSES OF MATERNAL DEATHS.....	12
TABLE 2. 4 NEONATAL, INFANT AND UNDER-FIVE DEATHS BY WHO REGION AND SELECTED SOUTHEAST ASIA COUNTRIES 2019	15
TABLE 2. 5 TOP 10 COUNTRIES WITH THE HIGHEST NUMBER OF NEONATAL DEATHS 2019.....	16
TABLE 2. 6 TOP 10 COUNTRIES WITH THE HIGHEST NUMBER OF CHILDREN UNDER-FIVE DEATHS 2019	16
TABLE 2. 7 CLINICAL INTERVENTIONS TO PREVENT AND TREAT MAJOR CAUSES OF MATERNAL DEATHS	20
TABLE 2. 8 CLINICAL INTERVENTIONS TO PREVENT AND TREAT MAJOR CAUSES OF CHILD DEATHS	22
TABLE 3. 1 INDONESIA HEALTH INDICATORS, SELECTED YEARS	27
TABLE 3. 2 HUMAN RESOURCE FOR HEALTH AVAILABILITY BY INDONESIAN PROVINCES, 2018.....	32
TABLE 3. 3 SIGNAL FUNCTIONS FOR EMERGENCY OBSTETRIC AND NEWBORN CARE.....	37
TABLE 3. 4 LEVELS OF HEALTH FACILITIES AND TYPE OF MCH SERVICES PROVIDED	41
TABLE 5. 1 SURVEYS AND OTHER DATASETS USED IN EACH THESIS CHAPTER	66
MANUSCRIPT 1 TABLE 1. DESCRIPTIVE STATISTICS, BY REGION.....	88
MANUSCRIPT 1 TABLE 2. DECOMPOSITION OF SBA USE GAPS BETWEEN JAVA-BALI AND OTHER REGIONS.....	89
MANUSCRIPT 1 TABLE 3. SENSITIVITY ANALYSES FOR DECOMPOSITION OF SBA USE GAPS BETWEEN JAVA-BALI AND THE REST OF INDONESIA	90
MANUSCRIPT 2 TABLE 1. COMPONENTS OF COVERAGE CASCADES AND INDICATORS FOR SELECTED INTERVENTIONS ALONG THE RMNCH CONTINUUM	106
MANUSCRIPT 2 TABLE 2. COVERAGE LEVELS AND CONCENTRATION INDICES FOR RMCH INTERVENTIONS IN 2002, 2007, 2012 AND 2017	108
MANUSCRIPT 3 TABLE 1. DESCRIPTIVE SUMMARY OF MATERNAL HEALTH SERVICE USE AND NEONATAL AND INFANT MORTALITY BY SOCIOECONOMIC AND GEOGRAPHICAL SUB-GROUPS, DHS 2017	129
MANUSCRIPT 3 TABLE 2. MULTILEVEL LOGIT REGRESSION OF ASSOCIATION BETWEEN JKN AND MATERNAL HEALTH SERVICES UTILIZATION OF A POOLED SAMPLED OF THE YEAR 2000-2017	130
MANUSCRIPT 3 TABLE 3. MULTILEVEL LOGIT REGRESSION OF ASSOCIATION BETWEEN JKN AND CHILD MORTALITY OF A POOLED SAMPLED OF THE YEAR 2000-2017.....	132
MANUSCRIPT 4 TABLE 1. SAMPLE CHARACTERISTICS BY TYPES OF PROVIDERS AND PLACE OF DELIVERY, 2018	145
MANUSCRIPT 4 TABLE 2. RELATIVE RISK RATIO (95% CONFIDENCE INTERVAL) FOR THE MULTINOMIAL LOGISTIC REGRESSION FITTED FOR THE CHOICE OF BIRTH ATTENDANT.....	146
MANUSCRIPT 4 TABLE 3. PREDICTED PROBABILITY OF PATIENT CHOICE OF DIFFERENT DELIVERY PROVIDERS	147
MANUSCRIPT 4 TABLE 4. MULTINOMIAL LOGIT RESULTS FOR CHOICE OF LEVELS OF FACILITIES	149
MANUSCRIPT 4 TABLE 5. PREDICTED PROBABILITY OF PATIENT CHOICE OF LEVEL OF HEALTH FACILITIES	150

List of Figures

FIGURE 2. 1 GLOBAL ESTIMATES OF MMR IN 2017	8
FIGURE 2. 2 GLOBAL NEONATAL AND UNDER-FIVE MORTALITY RATES AND NUMBER OF DEATHS, 1990-2019	17
FIGURE 2. 3 GLOBAL CAUSES OF NEONATAL DEATHS, 2017	18
FIGURE 2. 4 GLOBAL CAUSES OF POST-NEONATAL DEATHS, 2017	19
FIGURE 2. 5 JKN FINANCIAL PERFORMANCE, 2014-2018 (SEPTEMBER)	46
FIGURE 3. 1 INDONESIA MAP	26
FIGURE 3. 2 ORGANISATION OF HEALTH SYSTEM IN INDONESIA	29
FIGURE 3. 3 AVAILABILITY OF BEMONC SIGNAL FUNCTIONS AT PUSKESMAS, 2016.....	38
FIGURE 3. 4 JKN FINANCIAL PERFORMANCE, 2014-2018 (SEPTEMBER)	46
FIGURE 4. 1 FRAMEWORK OF STRENGTHENING HEALTH SYSTEMS TO IMPROVE MNCH OUTCOMES	53
FIGURE 4. 2 CASCADE OF HEALTH INTERVENTIONS AND THE POTENTIAL LOSS OF HEALTH BENEFITS ALONG THE CARE CASCADE	56
MANUSCRIPT 1 FIGURE 1. SKILLED BIRTH ATTENDANCE BY REGION IN INDONESIA, 2018	87
MANUSCRIPT 1 FIGURE 2. SKILLED BIRTH ATTENDANCE BY PROVINCE IN INDONESIA, 2018.....	87
MANUSCRIPT 2 FIGURE 1. CASCADE OF CARE FOR RMCH SERVICES, 2017	107
MANUSCRIPT 2 FIGURE 2. RMCH SERVICE COVERAGE, BY REGION 2017	109
MANUSCRIPT 2 FIGURE 3. RMCH COVERAGE BY WEALTH QUINTILE GROUPED BY OVERALL CRUDE COVERAGE RATE FOR 34 PROVINCES USING 2017 DHS.....	110
MANUSCRIPT 2 FIGURE 4. RMCH COVERAGE AND CONCENTRATION INDEX BY PROVINCE FROM 2002-2017 DHS.	111
MANUSCRIPT 2 FIGURE 5. RMCH COVERAGE AND CONCENTRATION INDEX FOR SELECTED PROVINCES AND INDICATORS, 2002-2017 DHS	112
MANUSCRIPT 3 FIGURE 1. INDONESIA NATIONAL HEALTH INSURANCE COVERAGE BY PROVINCE, 2019.....	126
MANUSCRIPT 3 FIGURE 2. UNADJUSTED TRENDS IN MATERNAL SERVICE UTILISATION COVERAGE FROM 2000-2017	127
MANUSCRIPT 3 FIGURE 3. UNADJUSTED TRENDS IN NEONATAL AND INFANT MORTALITY FROM 2000-2017	128
MANUSCRIPT 4 FIGURE 1. PREDICTED PROBABILITY OF PATIENT CHOICE OF DIFFERENT BIRTH ATTENDANTS, BY INSURANCE STATUS.....	148
MANUSCRIPT 4 FIGURE 2. PREDICTED PROBABILITY OF PATIENT CHOICE OF DIFFERENT HEALTH FACILITIES, BY INSURANCE STATUS.....	151

List of Appendices

MANUSCRIPT 1 APPENDIX 1. SAMPLE FLOWCHART	216
MANUSCRIPT 1 APPENDIX 2. DEFINITION OF VARIABLES	217
MANUSCRIPT 1 APPENDIX 3. LOGISTIC REGRESSION FOR SBA UTILIZATION, BY REGION	218
MANUSCRIPT 1 APPENDIX 5. DECOMPOSITION OF SBA USE GAPS BETWEEN JAVA-BALI AND OTHER REGIONS (USING OTHER REGION COEFFICIENT WEIGHTS).....	220
Manuscript 2 Appendix 1. Sample flowchart of 2002-2017 IDHS for Family Planning analyses	221
MANUSCRIPT 2 APPENDIX 2. SAMPLE FLOWCHART OF 2002-2017 IDHS FOR ANC AND MATERNAL DELIVERY ANALYSES.....	222
MANUSCRIPT 2 APPENDIX 3. SAMPLE FLOWCHART OF 2002-2017 IDHS FOR CHILD IMMUNISATION ANALYSES	223
MANUSCRIPT 2 APPENDIX 4. DESCRIPTION OF THE CASCADE OF RMCH INTERVENTIONS	224
MANUSCRIPT 2 APPENDIX 5. LIST OF VARIABLES.....	229
MANUSCRIPT 2 APPENDIX 6. SOCIOECONOMIC CHARACTERISTICS (% , [95% CI]), BASED ON SURVEY WAVE*	234
MANUSCRIPT 2 APPENDIX 7. TRENDS IN THE CONCENTRATION INDICES OF COVERAGE OF RMCH INTERVENTIONS, 2002-2017.....	235
MANUSCRIPT 2 APPENDIX 8. CONCENTRATION CURVE FOR EFFECTIVE COVERAGE OF RMCH SERVICE COVERAGE, 2017	236
MANUSCRIPT 2 APPENDIX 9. COVERAGE OF FAMILY PLANNING SERVICE BY WEALTH QUINTILE AND CONCENTRATION INDICES, 2002-2007	237
MANUSCRIPT 2 APPENDIX 10. TRENDS IN WEALTH-BASED EQUALITY IN ANTENATAL CARE SERVICE, 2002-2007 ...	238
MANUSCRIPT 2 APPENDIX 11. TRENDS IN WEALTH-BASED EQUALITY IN MATERNAL DELIVERY SERVICE, 2002-2007	239
MANUSCRIPT 2 APPENDIX 12. TRENDS IN WEALTH-BASED EQUALITY IN CHILD IMMUNISATION SERVICE, 2002-2007	240
MANUSCRIPT 2 APPENDIX 13. RMCH COVERAGE LEVELS, BY WEALTH QUINTILE 2017	241
MANUSCRIPT 2 APPENDIX 14. FAMILY PLANNING COVERAGE ACCORDING TO EFFECTIVE COVERAGE CASCADE, BY PROVINCE 2017.....	242
MANUSCRIPT 2 APPENDIX 15. ANTENATAL CARE COVERAGE ACCORDING TO EFFECTIVE COVERAGE CASCADE, BY PROVINCE 2017.....	243
MANUSCRIPT 2 APPENDIX 16. MATERNAL DELIVERY SERVICE COVERAGE ACCORDING TO EFFECTIVE COVERAGE CASCADE, BY PROVINCE 2017	244
MANUSCRIPT 2 APPENDIX 17. CHILD IMMUNISATION COVERAGE ACCORDING TO EFFECTIVE COVERAGE CASCADE, BY PROVINCE 2017.....	245
MANUSCRIPT 2 APPENDIX 18. PROVINCE GROUPING BASED ON 2017 PROVINCIAL CRUDE COVERAGE LEVEL (FAMILY PLANNING).....	246
MANUSCRIPT 2 APPENDIX 19. PROVINCE GROUPING BASED ON 2017 PROVINCIAL CRUDE COVERAGE LEVEL (ANTENATAL CARE)	246
MANUSCRIPT 2 APPENDIX 20. PROVINCE GROUPING BASED ON 2017 PROVINCIAL CRUDE COVERAGE LEVEL (MATERNAL DELIVERY)	246
MANUSCRIPT 2 APPENDIX 21. PROVINCE GROUPING BASED ON 2017 PROVINCIAL CRUDE COVERAGE LEVEL (CHILDHOOD IMMUNISATION)	247
MANUSCRIPT 2 APPENDIX 22. FAMILY PLANNING COVERAGE AND CONCENTRATION INDEX BY PROVINCE FROM 2002- 2017 DHS	248
MANUSCRIPT 2 APPENDIX 23. ANTENATAL CARE COVERAGE AND CONCENTRATION INDEX BY PROVINCE FROM 2002- 2017 DHS	249

MANUSCRIPT 2 APPENDIX 24. CHILDHOOD IMMUNIZATION COVERAGE AND CONCENTRATION INDEX BY PROVINCE FROM 2002-2017 DHS	251
MANUSCRIPT 3 APPENDIX 1. SAMPLE FLOWCHART	252
MANUSCRIPT 3 APPENDIX 2. LIST OF COVARIATES	253
MANUSCRIPT 3 APPENDIX 3. POPULATION COVERAGE OF JKN BY TYPES OF MEMBERSHIP, 2014-2019.....	254
MANUSCRIPT 3 APPENDIX 4. SAMPLE CHARACTERISTICS FROM FOUR DHS WAVES	255
MANUSCRIPT 3 APPENDIX 5. OUTCOME VARIABLES BASED ON SURVEY WAVES	256
MANUSCRIPT 3 APPENDIX 6. ESTIMATION OF MORTALITY RATES. RATES REFER TO THE 5-YEAR PERIOD PRECEDING EACH SURVEY.....	257
MANUSCRIPT 3 APPENDIX 7. INTRA-CLASS CORRELATION FROM THE MULTILEVEL LOGISTIC REGRESSION OF PROVINCE ON MATERNAL HEALTH SERVICES UTILIZATION AND CHILD MORTALITY	258
MANUSCRIPT 3 APPENDIX 8. MULTILEVEL LOGIT REGRESSION OF ASSOCIATION BETWEEN JKN AND MATERNAL HEALTH SERVICES UTILIZATION OF A POOLED SAMPLED 2000-2017	259
MANUSCRIPT 3 APPENDIX 9. MULTILEVEL LOGIT REGRESSION OF ASSOCIATION BETWEEN JKN AND CHILD MORTALITY OF A POOLED SAMPLED OF THE YEAR 2000-2017	260
MANUSCRIPT 3 APPENDIX 10. LOGISTIC REGRESSION FOR MODELS A-B TESTING DIFFERENT INTERACTION TERMS FOR THE ASSOCIATION BETWEEN JKN AND ANTENATAL CARE 4+	261
MANUSCRIPT 3 APPENDIX 11. LOGISTIC REGRESSION FOR MODELS A-B TESTING DIFFERENT INTERACTION TERMS FOR THE ASSOCIATION BETWEEN JKN AND SKILLED BIRTH ATTENDANCE	262
MANUSCRIPT 3 APPENDIX 12. LOGISTIC REGRESSION FOR MODELS A-B TESTING DIFFERENT INTERACTION TERMS FOR THE ASSOCIATION BETWEEN JKN AND INSTITUTIONAL DELIVERY.....	263
MANUSCRIPT 3 APPENDIX 13. LOGISTIC REGRESSION FOR MODELS A-B TESTING DIFFERENT INTERACTION TERMS FOR THE ASSOCIATION BETWEEN JKN AND CAESAREAN SECTION	264
MANUSCRIPT 3 APPENDIX 14. LOGISTIC REGRESSION FOR MODELS A-B TESTING DIFFERENT INTERACTION TERMS FOR THE ASSOCIATION BETWEEN JKN AND NEONATAL MORTALITY	265
MANUSCRIPT 3 APPENDIX 15. LOGISTIC REGRESSION FOR MODELS A-B TESTING DIFFERENT INTERACTIONS TERMS FOR THE ASSOCIATION BETWEEN JKN AND INFANT MORTALITY	266
MANUSCRIPT 3 APPENDIX 16. SENSITIVITY ANALYSIS FOR MATERNAL HEALTH SERVICES USE OUTCOMES: ‘FALSE’ INTERVENTION INITIATION TIMING (POLICY IN 2011 INSTEAD OF 2014).....	267
MANUSCRIPT 3 APPENDIX 17. SENSITIVITY ANALYSIS FOR CHILD MORTALITY OUTCOMES: DIFFERENT POLICY EARLIER YEAR INTERVENTION (POLICY IN 2011 INSTEAD OF 2014)	268
MANUSCRIPT 3 APPENDIX 18. SENSITIVITY ANALYSIS FOR MATERNAL HEALTH SERVICES USE OUTCOMES: BEFORE AND AFTER JKN EFFECT.....	269
MANUSCRIPT 3 APPENDIX 19. SENSITIVITY ANALYSIS FOR CHILD MORTALITY: BEFORE-AND-AFTER JKN EFFECT	270
MANUSCRIPT 3 APPENDIX 20. SENSITIVITY ANALYSIS FOR MATERNAL HEALTH SERVICES USE OUTCOMES: SHORTER TIME PERIOD (2005-2017).....	271
MANUSCRIPT 3 APPENDIX 21. SENSITIVITY ANALYSIS FOR CHILD MORTALITY OUTCOMES: SHORTER TIME PERIOD (2005- 2017).....	272
MANUSCRIPT 4 APPENDIX 1. SAMPLE FLOWCHART	273
MANUSCRIPT 4 APPENDIX 2. MULTINOMIAL LOGIT RESULTS FOR TYPES OF PROVIDER	274
MANUSCRIPT 4 APPENDIX 3. MULTINOMIAL LOGIT RESULTS FOR PLACE OF DELIVERY	275

Chapter 1: Introduction

This chapter outlines the background and significant of the research (section 1.1), its research question and scope (section 1.2), its contribution to the literature (section 1.3). Section 1.4 include an outline of the remaining chapters of the thesis.

1.1 Background

Maternal and child mortality are among the most sensitive indicators of development and of functioning health systems. Significant progress has been made in reducing maternal and child mortality. Between 2000 and 2017, the global maternal mortality ratio (MMR) has declined by 38%; from 400 to 211 per 100,000 live births (World Health Organization 2020a). And from 2000 to 2019, child mortality rates have declined as well; the neonatal mortality rate (NMR) from 30.3 to 17.7; the infant mortality rate (IMR) from 52.8 to 28.2 and; under-five mortality rate (U5MR) from 75.8 to 37.7 per 1,000 live births (United Nations IGME 2020). However, the burden of maternal and child mortality remains high where around 295,000 women lost their lives from pregnancy and childbirth-related complications and around 5 million children under-five die annually. While some countries managed to achieve MDGs 4 and 5, slow progress in reducing maternal and child mortality resulted in the failure to achieve any of maternal and child-health related goals of the Millennium Development Goals (MDGs) at the global level (United Nations 2016a). For instance, the global MMR in 2015 was 210 per 100,000 live births, which is significantly higher than the MDG 5 target of 80 per 100,000 live births. Similarly, U5MR at 43 per 1,000 live births in 2015 was much higher than the MDGs target of 30 per 1,000 live births.

In the post-MDG era, the Sustainable Development Goals (SDGs) aimed to meet the MDGs unfinished agenda in global health, including those pertaining to maternal, reproductive and child health. The SDGs are designed to be more cross-sectoral with the hopes to advance the progress more quickly and achieve new global targets by 2030. Goal 3 of the SDGs includes 13 sub-goals, which call for a reduction in global maternal and child mortality. By 2030, the goal is to reduce maternal mortality to be less than 70 per 100,000 live births, neonatal mortality to be less than 12 per 1,000 live births and under-five mortality to 25 per 1,000 live births. As part of Goal 3, there is also a call to ensure access to universal access to sexual and reproductive health services including through the provision of family planning information, education and services, and integrating reproductive health services into the national programs and strategies (United Nations 2015). Failing to improve equitable access to quality reproductive, maternal and child health services will be a major hinderance in achieving the SDGs Goal 3.

Most maternal and child deaths are avoidable through evidence-based health interventions. The WHO and global systematic reviews have recommended a set of interventions that are

effective in preventing maternal and child deaths for LMICs including contraceptive use, antenatal care, skilled birth attendance, childhood immunisation and emergency obstetric and neonatal care services (Bhutta et al. 2014; Lassi et al. 2014; Gülmezoglu et al. 2016; World Health Organization 2010a, 2014). The scaling up of these interventions is the main strategy to improve maternal and child survival in low and middle-income countries (LMICs). Evidence suggests that several of these interventions are simple and affordable for low and middle-income countries (LMICs) (Wall et al. 2010). For example, meeting the need for modern contraceptive could halve abortion-related deaths and save more than USD 1 billion (Goldie et al. 2010). However, there are concerns about how the improvement in the coverage levels of these interventions may widen the existing health inequalities.

According to the ‘inverse equity hypothesis’, the expansion of health interventions (e.g. skilled birth attendance, vaccination) within existing health care systems may differentially benefit more advantaged population—at least at the initial stage of the scaling up—leading to increased socioeconomic inequalities in health service utilisation and outcomes (Neal et al. 2015; Adegbosin et al. 2019; Victora 2008; Boerma et al. 2018). Therefore, health inequality should be taken into account in scaling up MCH interventions. Policies are in place to scale up MCH interventions, including strengthening the delivery services through programs that aim to improve the availability and quality of human resource as well as health infrastructures. User-fees reduction programs, including the expansion of social health insurance programs, are also aimed to improve the coverage of key MCH interventions. However, the extent to which policies affect the existing socioeconomic inequalities within the country is unclear.

There is also a growing interest to understand the effect of health system strengthening efforts in improving the delivery of MCH interventions. Previous evidences have shown that governments with greater financial autonomy and decision making authority are more effective in delivering effective maternal and child health interventions and in effect, gain better health outcomes (Ergo et al. 2011, 2010). However, there are still limited evidence from LMICs that assess MCH inequalities under the health systems perspective. This would require a more thorough assessment of not just the socioeconomic and demographic determinants, but also looking at how the health systems function within country-specific contexts.

The SDGs emphasises the importance of universal health coverage (UHC) for all population, i.e. ensuring access to quality health services for all population regardless of the socioeconomic status and without risking financial hardship (United Nations 2016b). One of the key policies to achieve this is by introducing or expanding social health insurance program. As a form of user-fee reduction, health insurance coverage increases the probability of using health services through reduced cost associated with health care, which would then lower the out-of-pocket payment (OOP) borne by the population. The low OOP would then remove the financial barriers to health service and serve as an incentive for better health-seeking behaviour and provides more choices in accessing health care

providers. Countries are implementing national health insurance program to reduce user-fees and studies have shown that insurance coverage increases the probability of using services generally (Wagstaff 2007; Wang, Temsah & Mallick 2017; Aggarwal 2010; Lagarde & Palmer 2008; Qin et al. 2019). However, there is still a need to assess how such policy has alleviated the inequality in MCH service use and outcomes.

Improving the quality of MCH services has been identified as key instruments in the global MCH agenda and MCH service quality improvement has been the main research area in the last decade. While the coverage levels of many MCH interventions have increased significantly, the benefits of the interventions on health outcomes are not as effective. This is partly due to the quality of the interventions. For instance, according to a global report, the majority (90%) of pregnant women receive at least one antenatal care (ANC) visit (Countdown to Collaboration 2018). However, only 57% received the recommended four or more ANC visits and even lower percentage (33%) received the necessary component of ANC, i.e. iron-folic acid supplementation (Hodgins & D'Agostino 2014). Such gap between the coverage of ANC visit and the actual interventions received by the women reflect that the quality of ANC services is still low and have led to unwanted health outcomes, for both women and newborns. One of the novel approaches to capture the quality of care of MCH services is by using the effective coverage framework. The effective coverage framework is based on the idea that a comprehensive assessment of the health system should incorporate the measurement of the completeness of services received and the quality of the service (Evans 2003; Shengelia et al. 2005; Amouzou et al. 2019; Marsh et al. 2020). In MCH, the effective coverage approach could be used to identify the gaps in quality of care and rooms for improvement. There is a need to expand the use of effective coverage framework in monitoring the quality and progress of MCH interventions.

This thesis focuses on Indonesia, a low and middle-income country (LMIC) with the fourth largest population and archipelago in the world. Indonesia is geographically and culturally diverse with 34 provinces and more than 500 districts and under decentralised health systems. The level of readiness of the health service delivery varies across regions, provinces, and districts. Indonesia has a high burden of maternal and child mortality. Indonesia current MMR is 177 per 100,000 live births, which is one of the highest in the Southeast Asia region (World Health Organization 2020a). The NMR, at 12.4 per 1,000 live births is also comparably higher to its neighbouring countries such as Singapore (0.9) and Malaysia (4.6) (UN IGME 2020).

Socioeconomic and geographical inequality in maternal and child health service utilisation and outcomes is also apparent in Indonesia. For instance, only 45% of the poorest quintile delivered in a health care setting compared to 94% of the richest quintile. Women living in urban areas were also more likely to receive quality antenatal care (ANC) services compared to their rural counterparts (National Population and Family Planning Board (BKKBN) et al. 2018). A previous study has also documented much higher rates of child mortality in less-developed regions of Indonesia (Hodge et al. 2014). For instance, the IMR in Papua province

was 54 per 1,000 live births, which was substantially higher than the national average (32) and the most developed province of Jakarta (22) (Central Bureau of Statistics 2018a). While studies from Indonesia have documented the determinants that drive socioeconomic inequalities in MCH service utilisation (Titaley, Dibley & Roberts 2010, 2009, 2011; Houweling et al. 2006; Hodge et al. 2014; Tripathi & Singh 2017; Teplitskaya & Dutta 2018), there is still limited assessment on the disparities between regions. Further, there is no current study that assesses the inequalities using a health systems perspective. Such large disparity is partly due to variations in access to high-quality maternal and child health services, stemming from inequitable distribution of health care workers, infrastructure that affect financial and geographical ability to access health services.

In 2014, the government of Indonesia launched the largest single-payer social health insurance scheme in the world (Agustina et al. 2018). The program aimed to cover all 270 million population by 2019 and as of 2020, the population coverage was at 82.4% (BPJS Kesehatan 2020a). While the program has resulted in a general increase in health care utilisation (Erlangga, Ali & Bloor 2019; Aji et al. 2013; Agustina et al. 2018), evidence on the effect of insurance on alleviating socioeconomic and geographical inequalities in MCH service use and health outcomes is still limited (Anindya, Lee, McPake, Wilopo & Carvalho 2020; Nasution, Mahendradhata & Trisnantoro 2019). The few studies available were limited to MCH service utilisation and did not assess the impact of JKN on health outcomes as well as how JKN may have improved the socioeconomic and geographical equity in health over time. Given that the program is one of the largest investments in the Indonesian health systems, it is crucial to evaluate the effect of the program in addressing socioeconomic and geographical inequalities in health service utilisation, including in the context of MCH.

1.2 Aim and objectives

The aim of this thesis is to understand the socioeconomic and health systems determinants that affect inequalities in maternal and child health care utilisation and outcomes.

The specific objectives are:

1. To identify region-specific socioeconomic and health systems variables and quantify their contributions towards inequality in maternal health care utilisation, by conducting a decomposition analyses of the geographical inequality in skilled birth attendance utilisation (Chapter 6).
2. To assess the current situation and trends over time in RMCH service coverage in Indonesia and to understand the potential pathways towards high coverage levels with respect to distribution by using the effective coverage framework (Chapter 7).
3. To evaluate the impact of health insurance or policy abolishing user fees for maternal and child health services on the inequalities in maternal and child health service utilisation and outcome (Chapter 8).
4. To assess the impact of national health insurance on women's choice in the type of birth attendants and place of delivery (Chapter 8).

The summary of the methods chosen to meet the four objectives in this thesis is outlined in table 1.1.

Table 1. 1 Objectives of the thesis and methods used

No.	Objective	Methods
1	To identify the contribution of region-specific socioeconomic and health systems factors on inequality in skilled birth attendance	Decomposition analysis using Indonesia Socioeconomic Household Survey (Susenas) 2018 dataset and Ministry of Health's 2018 databases on health facilities and human resource to measure the magnitude of geographical inequalities and factors that affect the inequalities
2	To assess the current situation and trends over time in RMCH service coverage in Indonesia and to understand the potential pathways towards high coverage levels with respect to distribution by using the effective coverage framework	Pooled cross-sectional analysis using Indonesia Demographic Health Survey 2002/2003, 2007, 2012 and 2017 to measure socioeconomic and geographical inequalities in MCH service utilisation and assess potential pathways towards high coverage level by analysing equity at different stages towards high quality in different provinces over time.
3	To evaluate the impact of Indonesia health insurance program on the inequalities in maternal and child health service utilisation as well as child mortality	Multilevel interrupted time-series analyses using Indonesia Demographic Health Survey 2002/2003, 2007, 2012 and 2017 to assess the impact of Indonesia health insurance program on MCH service use and neonatal and infant mortalities.
4	To assess the impact of the national health insurance on women's choice in the type of birth attendants and place of delivery	Multinomial regression using Susenas 2018 dataset to assess the effect of insurance coverage on the choice of types of skilled birth attendant and levels of health facility for maternal delivery.

1. 3 Contribution of the thesis

This thesis contributes to the literature significantly in the following ways. First, this study investigates the contribution of both demand and health supply-sides towards the geographical variations in maternal health service utilisation by employing the most recent nationally-representative dataset. This is the first detailed analysis that uses the most recent nationally-representative dataset coupled with a rich set of health supply-side information. Unlike previous studies that have only included demand-side factors, this study focuses on the health systems variables that are amenable through health policies and programs. The methods used and the findings would be applicable to other settings beyond Indonesia, specifically for studies assessing inequalities in health services utilisation. Second, this thesis provides the first comprehensive assessment on the coverage and socioeconomic inequalities over time in the coverage of a wide range of key MCH interventions using the effective coverage framework. This allows monitor socioeconomic and geographical inequalities in MCH service utilisation by including quality aspects of the intervention. More importantly, this thesis also explores different pathways towards high coverage levels with respect to distribution of MCH services. This offers new insights on possible different

delivery models that could help improve health equity in Indonesia as well as in countries with similar challenges in MCH service use inequalities. Third, the study provides a timely evaluation of the impact of JKN on socioeconomic inequality in MCH service utilisation as well as child mortality outcomes. The methods used and the findings would contribute to the existing literature, particularly those focusing on the assessment of the expansion of national health insurance, which is one of the key strategies to reach universal health coverage. Fourth, the study examines how insurance coverage affects women's choice for delivery service and how the effect varies across socioeconomic and geographical groups. This is done by first looking at the types of skilled birth attendant and the levels of care utilised (e.g. secondary or primary health facilities), which has not been assessed in the previous literature. The empirical findings would provide further evidence on how the user-fee removal policy affects the inequality in MNCH service utilisation and outcomes while also highlighting the possible unintended consequences of the policy. The assessment would also help inform other countries with similar settings that are embarking on expanding their national health insurance coverage. Finally, while this thesis focuses on Indonesia, the approaches used and policy recommendations may be applicable to other LMICs with similar contexts.

1. 4 Organisation of the thesis

The current burden on maternal and child health at the global and Indonesian levels is presented in Chapter 2. An overview of the causes of maternal and child deaths is also presented along with the evidence-based interventions that could reduce maternal and child mortality. This would serve as the basis of the selection of health care service variables that are included in the thesis. Chapter 3 presents an overview of Indonesia, which is the focus of this study. The overview includes the Indonesian health system and more specifically health system delivery for maternal and child health.

As the thesis aims to explore the levels of inequality and the socioeconomic and health system determinants in the use of the interventions and child health outcomes, Chapter 4 presents the current state of the literature on several key issues. First is the review of frameworks related to maternal and child health-seeking behaviour, health systems strengthening framework, and the effective coverage framework for maternal and child health service delivery. These frameworks were then adapted to guide this study. Further, the review summarises the determinants that may affect health care utilisation including socioeconomic and health systems factors, at the global level and from studies on Indonesia. As this study also aims to assess the impact of the social health insurance program on maternal health care, Chapter 4 also summarises existing literature that assessed the impact of health insurance maternal and child health care services.

As this Thesis is produced with four accompanying publications, Chapter 5 provides the details of the datasets used in the analyses. Chapter 6, 7, and 8 present the results and full discussion relating to the four papers. Finally, Chapter 9 summarises the important findings from across the papers and discusses the policy implications of these findings and

recommendations to further improve MCH programs implementation and direction for future research.

Chapter 2: Maternal and child health: Global and Indonesia

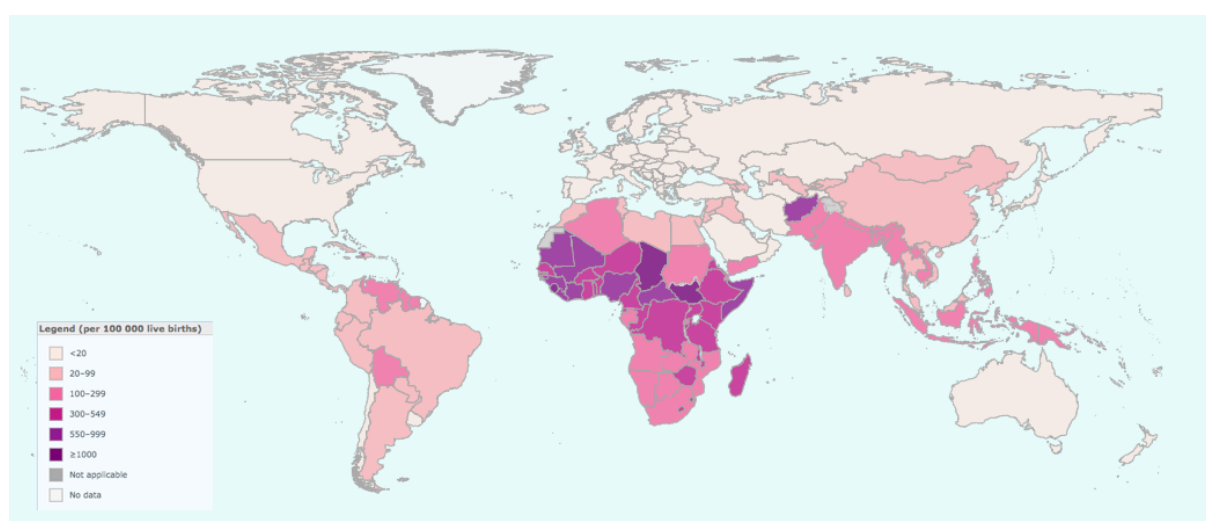
2.1 Maternal health burden: Global and Indonesia

Global maternal health has improved with a significant global reduction in pregnancy and delivery-related deaths. The maternal mortality ratio (MMR) declined from around 400 in 2000 to 211 per 100,000 livebirths in 2017 (World Health Organization 2020b). This translates to around 38% reduction over the period of 2000-2017. However, the rate means that in 2017 alone, a total of 295,000 women died in the period during and following pregnancy and childbirth worldwide.

The majority of maternal deaths occur in low and middle-income countries (LMICs) with around 86% concentrated in South Asia and Sub-Saharan Africa regions. In high-income countries, the average maternal mortality rate is approximately 10 per 100,000 live births. In contrast, MMR for Sub-Saharan Africa and South Asia are around 547 and 182 per 100,000 livebirths, respectively.

Indonesia has also made significant progress in maternal health and between 1990 and 2017, the MMR declined from 446 to 177 per 100,000 livebirths. However, this progress was not rapid enough and Indonesia failed to achieve the Millennium Development Goal 5 (MDG 5) target in 2015 (United Nations 2016a). Indonesia's current MMR is also one of the highest in Southeast Asia region and is significantly higher compared to its neighbouring countries such as Malaysia (29 per 100,000 livebirths) or the Philippines (121 per 100,000 livebirths) (World Health Organization 2020a). Figure 2.1 and Table 2.1 show the MMR for the year 2017 across world regions and for selected countries in Southeast Asia.

Figure 2. 1 Global estimates of MMR in 2017



Source: Based on data from the UN inter-agency estimation for maternal mortality (World Health Organization 2020a)

In terms of the absolute number of deaths, with a large population of around 270 million people, Indonesia contributed a sizeable burden of maternal deaths, both within the Southeast Asia region and globally. As seen from table 2.1, the estimated number of women dying from pregnancy and childbirth-related complications was around 8,600 deaths in 2017 alone or around 16.2% and 2.9% of maternal deaths in the Southeast Asia region and worldwide, respectively.

Table 2. 1 Maternal deaths by WHO region and selected Southeast Asia countries 2017

Region/Country	MMR (per 100,000 live births) (95% CI)	Number of maternal deaths (95% CI)
Worldwide	211 (199 – 243)	295,000 (279,000 – 340,00)
Africa	525 (480 – 629)	192,000 (176,000 – 230,000)
Americas	57 (55 – 62)	8,500 (8,100 – 9,200)
Europe	13 (12 – 14)	1,400 (1,300 – 1,600)
Eastern Mediterranean	164 (138 – 217)	30,000 (25,000 – 39,000)
Western Pacific	41 (36 – 49)	9,800 (8,600 – 12,000)
Southeast Asia	152 (132 – 180)	53,000 (46,000 – 63,000)
Indonesia	177 (127 – 254)	8,600 (6,200 – 12,000)
Singapore	8 (5 – 13)	4 (3 – 6)
Malaysia	29 (24 – 36)	150 (130 – 190)
Brunei Darussalam	31 (21 – 45)	2 (1 – 3)
Thailand	37 (32 – 44)	270 (230 – 320)
Vietnam	43 (32 – 61)	700 (510 – 980)
Philippines	121 (91 – 168)	2,700 (2,000 – 3,700)
Cambodia	160 (116 – 221)	590 (430 – 810)
Lao People's Democratic Republic	185 (139 – 253)	310 (230 – 420)
Source: Based on data from the UN inter-agency estimation for maternal mortality (World Health Organization 2020a)		

The calculation of MMR in many LMICs is complicated by the limited availability of reliable civil registration and death reporting (Say et al. 2014; Say & Chou 2011; Hounton et al. 2013). The situation also applies to Indonesia, where civil registration is not reliable and the classification of deaths, including maternal and child deaths, does not always follow standardised classification methods. A study conducted in 2007 revealed that only 11-19% of death records in Indonesia included the cause of mortality (MoH 2007). In addition, it was also estimated that there could be around 40% of underreporting of deaths in Indonesia (Kosen 2015).

The government of Indonesia primarily uses the Indonesian Demographic and Health Survey (DHS) as the data source to calculate the MMR for the Development Millennium Goals (MDG). The DHS provides estimates over a five-year period prior and including the survey year. For instance, in 2012, DHS provides a point estimate of 359 deaths per 100,000 live births. However, there are several issues in the use of DHS datasets in calculating the MMR.

First, the DHS relies on the ‘sisterhood method’ where each woman in a household that was surveyed under DHS provided the information on the survival status of all her liveborn siblings (Mgawadere, Kana & van den Broek 2017). For any female sibling who died at the age of 10 years or older, further information is sought to determine whether the death was pregnancy-related. This includes deaths during pregnancy, childbirth or within 2 months following the end of a pregnancy. While the sisterhood method allows for a larger sample of women to be included in the MMR calculation, because all female siblings of the interviewees would be included, the final number of deaths captured by the Indonesian DHS remained small. For example, in 2012, only 92 maternal deaths were reported (Bureau of Statistics Indonesia et al. 2013), which resulted in a wide confidence interval. Further, the measurement of mortality using the sisterhood method dates back to up to 7-12 years and hence, does not provide the point estimate for the given year when the survey was conducted.

The Indonesian government also uses the population census to calculate the MMR. The census is conducted every decade with an inter-census survey deployed every 5-year in between the census. In 2010, for example, the Indonesia population census identified 8,075 pregnancy-related deaths and 5,866,791 live births (Cameron, Contreras Suarez & Cornwell 2019). Unlike the sisterhood method applied by the DHS, the Indonesia population census collected the information on pregnancy-related deaths by asking about the occurrence of deaths within the household, as opposed to inquiring about the survival of the female siblings of women interviewees.

While the strength of the population census in accounting for maternal mortality is in the large number of maternal deaths captured, the census has some limitations. First is the possible underreporting of maternal deaths by the survey respondents and the fact that information on births from unmarried women is not available. The latter is important in the calculation of the ratio because the number of live births serves as the denominator in the MMR calculation. Cases of maternal deaths in which the deceased women were not part of any surviving household would also be uncounted for in the census, which would contribute to underestimation of the MMR. In addition, as the census is conducted once every decade, the point estimates provided by the survey would not allow for continuous monitoring of MMR.

There are also inconsistencies in the MMR calculation results across the various surveys. As analysed by Cameron et al., the MMR calculated from the census was 137 deaths per 100,000 live births (Cameron, Contreras Suarez & Cornwell 2019), which was much lower than the UN estimates for the same year (228 per 100,000 live births) as well as the 2012 DHS survey at 359 per 100,000 live births. As shown in Table 2.2, the variability in the MMR estimations in Indonesia highlights the difficulty in providing reliable calculations of maternal deaths.

Another approach used to calculate the MMR in Indonesia and globally is the UN estimates, which draw on a variety of data sources (including the projection of the MMR from the

latest census as well as the DHS) and also in part, constructed using a multi-level regression model using variables such as gross domestic product (GDP), general fertility rates and rates of SBA coverage to predict the proportion of deaths due to maternal causes among women of reproductive age. However, the UN estimates also have limitations of their own. For example, given the large variations in Indonesia's geographical and population characteristics, using rates of SBA to predict MMR might not capture the variations in the variations in actual access to the services, the varying degrees of quality of care as well as access to essential equipment and medicines (Cameron, Contreras Suarez & Cornwell 2019).

Table 2. 2 Variability in the estimates of maternal mortality in Indonesia 2000-2017

Maternal mortality ratio per 100,000 live births	Year	Source
339	1996-2003	DHS 2002/2003
272	2000	UN estimates
307	2002	DHS sisterhood 2002/2003
319	2003	UN estimates
252	2005	UN estimates
228	2007	DHS sisterhood 2007
181	2007	UN estimates
228	2010	UN estimates
259	2010	Indonesia population census
313	2012	UN estimates
359	2012	DHS
192	2015	UN estimates
305	2015	Inter-census 2015
177	2019	UN modelled estimates 2017
Source: (Bureau of Statistics Indonesia et al. 2013; Central Bureau of Statistics, National Family Planning Coordinating Board (BKKBN) & Inc. 2008, 2008; Central Bureau of Statistics Indonesia, National Population and Family Planning Board (BKKBN) & Calverton 2003; World Health Organization 2019a)		

2.2 Causes of maternal deaths

In order to understand the interventions that are required to address the maternal health burden, the understanding of the causes of maternal deaths is critical. However, similar to challenges in calculating reliable estimates for MMR, determining a particular cause of maternal death is often complex, particularly in LMICs with limited health system support. A significant number of maternal deaths occur outside of health facilities and even among those that did, not all maternal deaths were recorded or classified accordingly (Say et al. 2014).

In low- and middle-income countries (LMICs), the accuracy in the classification of maternal deaths is complicated by the lack of intense surveillance and the availability of quality data sources. Further, complete registration and routine medical certification of cause of

maternal death are lacking (Graham et al. 2016; Streatfield et al. 2014; Hounton et al. 2013; Graham et al. 2008). The lack of standardised methods and capacity to measure and monitor the change in maternal deaths and the causes have also compounded the effort to provide an accurate classification of maternal deaths in LMICs.

The latest system used to classify the causes of maternal deaths is the revised version of the International Classification of Disease 10th (ICD-10) edition to include more specific causes of deaths during pregnancy, delivery, and the postpartum period, or called the ICD-10 MM. The ICD-10MM differs from the ICD-10 in classifying some suicides and accidental deaths as maternal deaths and not as incidental deaths. The ICD-10MM is also recommended by the WHO in order to provide consistent collection, analyses, and interpretation of information relating to maternal deaths (World Health Organization 2012). In this updated system, causes of maternal deaths are categorised into: abortion, haemorrhage, hypertension, embolism, sepsis, other direct causes (including obstructed labour), and indirect causes (including non-communicable diseases, HIV, anaemia and suicide) (Say & Chou 2011).

ICD-10MM also allows for categorisation of causes of maternal deaths that may result from causes pertaining to previous existing diseases, such as diabetes, asthma, and cardiovascular diseases. These conditions may be exacerbated or become worse due to pregnancy, which may result in maternal deaths. By taking these indirect obstetric causes of death, this classification enables a focus on the quality of pregnancy-related care by providing insights into the contribution of non-obstetric conditions that encourages obstetric professionals to collaborate with other professionals in other fields of medicine (Akker et al. 2017).

According to global and regional estimates by Say et al. (Say et al. 2014), the main causes of maternal deaths include antepartum and postpartum haemorrhage, hypertensive disorders during pregnancy, sepsis, and complications due to abortions (Table 2.3). A follow-up study to the Indonesia population census in 2010 that aimed to determine the causes of pregnancy-related death is also included in the table below. Both publications used the ICD-10MM classification to define the cause of maternal mortality.

Table 2. 3 Global and regional causes of maternal deaths

	Haemorrhage (UI)*	Hypertension	Sepsis	Abortion	Embolism	Other direct causes	Indirect causes
Worldwide	27.1% (19.9-36.2)	14.0% (11.1-17.4)	10.7% (5.9-18.6)	7.9% (4.7-13.2)	3.2% (1.8-5.5)	9.6% (6.5-14.3)	27.5% (19.7-37.5)
Developed regions	16.3% (11.1-24.6)	12.9% (10.0-16.8)	4.7% (2.4-11.1)	7.5 % (5.7-11.6)	13.8% (10.1-22.0)	20.0% (16.6-14.3)	27.5% (19.7-37.6)
Developing regions	27.1% (19.9-36.4)	14.0% (11.1-17.4)	10.7% (5.9-18.7)	7.9% (4.7-13.2)	3.1% (1.7-5.4)	9.6% (6.4-14.3)	27.5% (19.7-37.6)
Southeast Asia	29.9% (15.2-51.3)	14.5% (8.4-22.7)	5.5% (1.8-15.0)	7.4% (2.8-18.4)	12.1% (3.2-33.4)	13.8% (5.6-31.2)	16.8% (7.8-34.2)
Indonesia	22.1%	10.2%	9.8% ^a	1.2% ^b	1.3%	38.0%	23.7%
* Estimated proportions of the cause of maternal death (in %) with uncertainty interval (UI) ^a Includes puerperal sepsis and maternal infectious and parasitic diseases ^b Includes only spontaneous abortion Source: Say et al. (2014) for global data and Afifah et al. (2016) for Indonesia data							

As shown in Table 2.3, the primary direct cause of maternal death at the global level is haemorrhage. For Indonesia, haemorrhage as an individual category, was also the primary cause of death. The other direct causes in Indonesia caused 38% of maternal deaths. However, the grouping for this category was different from the global level estimate, particularly in how abortion was grouped. For abortion as the cause of death, there are some differences between findings from the Indonesian census and global data. Globally, abortion contributed around 7% of total maternal deaths as opposed to 1.2% in Indonesia. The differences may be due to the fact that the Indonesia population census follow-up study only included spontaneous abortion. This is different from the global study by Say et al., (2014) that also included ectopic pregnancy. Further, the classification of deaths due to unsafe abortion specifically, is prone to misclassification that could lead to underreporting. And as induced abortion is illegal in many LMICs, including in Indonesia, women who have undergone abortion would not be likely to disclose their attempts (Gerdtts, Vohra & Ahern 2013). Family members, who in the Indonesian census are the ones to report the maternal deaths, would be less likely to disclose the information on the abortion. In such circumstances, the overall number of maternal deaths may not be affected because abortion-related deaths may be classified under haemorrhage, sepsis, or other direct maternal death causes.

The indirect causes of maternal deaths are also important to look at as more than one-quarter of deaths were linked to indirect causes. In both high-income and low and middle-

income countries, non-communicable diseases have increasingly contributed to global maternal deaths (Maro et al. 2016; Gumanga et al. 2011; Engin-Üstün et al. 2019; Schutte et al. 2010). Chronic respiratory diseases, diabetes, cardiovascular diseases, and cancers have been documented to be among the main contributors of indirect causes of maternal deaths (Say et al. 2014). Non-communicable diseases have also been shown to increase the risks of both direct and indirect causes of maternal deaths (Benirschke, Burton & Baergen 2012; Pettitt et al. 1980; Hawthorne 2011). Taking obesity as an example, studies have shown that obesity in pregnant women would significantly increase the risks of death from cardiac disease (as an example of an indirect cause of maternal deaths) and also making pregnant women more prone to experiencing severe obstetric haemorrhage, eclampsia or uterine rupture, which are all direct causes of maternal deaths (Witteveen et al. 2013; Knight et al. 2016). In addition, NCDs or unhealthy lifestyles (e.g. smoking during pregnancy) not only increases the risk of maternal mortality but also the risk for the newborn. For example, smoking during pregnancy increases the risk of asthma, respiratory infections, and sudden infant death syndrome in children (World Health Organization 2010b).

There has also been a shift in the place where maternal deaths occur, mainly due to the increase in coverage level of facility-based delivery. Based on Indonesia 1991 DHS, for instance, 78.6% of deliveries occurred at home (Central Bureau of Statistics, National Family Planning Coordinating Board (BKKBN) & Inc. 1992). The proportion of home deliveries then decreased to 21% in 2017 (National Population and Family Planning Board (BKKBN) et al. 2018). The increase in the coverage of facility-based delivery followed the introduction of initiatives that aimed to promote safer deliveries such as the safe motherhood programme, and Indonesia was among the countries that have adopted facility-based delivery as the evidence-based recommendation for safer pregnancy and delivery (Kerber et al. 2007; Bhutta et al. 2013). Such shift in the place of deliveries has resulted in decreasing rates of maternal and neonatal mortality due to better hygiene conditions at the health facilities and more timely access to emergency obstetric care.

However, in Indonesia, there has also been a shift in where maternal deaths occur, i.e. from home to facility setting. The most recent available information on the place of maternal deaths in Indonesia is from the follow-up study of the population census that was published in 2016. The study shows 31.4% of maternal deaths occurred at home and the majority of deaths (68.6%) were in health facilities. However, there has been no published material on the place of maternal deaths prior to the census. Several explanations pertaining to the deaths occurring at the health facilities mainly relate to the readiness of the facility and the level of care available in those facilities. A study by Rajan et al. (2018) showed that most primary health care centres in Indonesia have only basic amenities and, in most cases, have a limited number of skilled birth attendants at the facility. And thus, even though more deliveries are now occurring at health facilities, the safety and the outcome of pregnancy and delivery are highly dependent on the types and readiness of those facilities.

2.3 Child health burden: Global and Indonesia

Significant progress has been made in child health since the start of the MDG timescale in 1990. The neonatal mortality rate (NMR), defined as the probability of dying during the first 28 days of life, was reduced from 36.6 per 1,000 live births in 1990 to 17.7 per 1,000 live birth in 2019 (United Nations IGME 2020). The infant mortality rate, or the probability of dying between birth and 1 year of age, was also reduced within the same period, from 65 to 29 deaths per 1,000 live births. Under-five mortality rate also lowered from 93 per 1,000 live births in 1990 to 38 in 2019. Along with the global decline in child mortality, Indonesia has also made significant progress in improving child survival. Between 2000 and 2019, the neonatal mortality rate was reduced from 22.8 per 1,000 live births to 12.4; infant mortality rate was halved from 41.0 to 20.2 and; the under-five mortality rate from 52.2 to 23.9 (United Nations IGME 2020).

As seen from table 2.4, the highest burden of child mortality is concentrated in Africa, Eastern Mediterranean, and Southeast Asia regions. Indonesia's child mortality rates are also among the highest within the Southeast Asia region. For instance, Indonesia's 2019 neonatal mortality at 12.4 per 1,000 live births was higher than neighbouring countries such as Singapore (0.9), Malaysia (4.6), and the Vietnam (10.5). Indonesia's infant mortality rate at 20.2 per 1,000 live births was ten-fold the rate of Singapore (2.1) and almost thrice the rate of Malaysia (7.3).

Table 2. 4 Neonatal, infant and under-five deaths by WHO region and selected Southeast Asia countries 2019

Region/Country	Neonatal mortality rate	Infant mortality rate	Under-five mortality rate
Worldwide	17.7	28.9	38.6
Africa	27.2	51.8	75.9
Americas	7.4	11.5	13.5
Europe	4.6	7.5	8.6
Eastern Mediterranean	25.9	37.2	46.9
Western Pacific	5.8	9.8	11.8
Southeast Asia	20.2	27.6	33.6
Indonesia	12.4	20.2	23.9
Singapore	0.9	2.1	2.5
Malaysia	4.6	7.3	8.6
Brunei Darussalam	5.9	9.6	11.4
Thailand	5.3	7.7	9.0
Vietnam	10.5	15.9	19.9
Philippines	13.3	21.6	27.3
Cambodia	14.5	22.8	26.6
Lao People's Democratic Republic	21.9	36.4	45.5

Source: United Nations IGME 2020, *Child Mortality*, United Nations Inter-agency Group for Child Mortality Estimation <<https://data.unicef.org/topic/child-survival/under-five-mortality/>>; World Health Organization 2020, 'Global health observatory data repository: child mortality', <<https://apps.who.int/gho/data/view.main.CM1300R?lang=en>>.

Despite the progress in child survival, reducing child mortality remains an urgent concern. In 2019 for instance, around 14,000 children under-five die every day and approximately 2.4 million children died within the neonatal period or the first four weeks of life (World Health Organization 2019b). In 2019, Indonesia was consistently included in the top 10 countries with the highest number of neonatal and children under-five deaths as seen from Table 2.5 and 2.6.

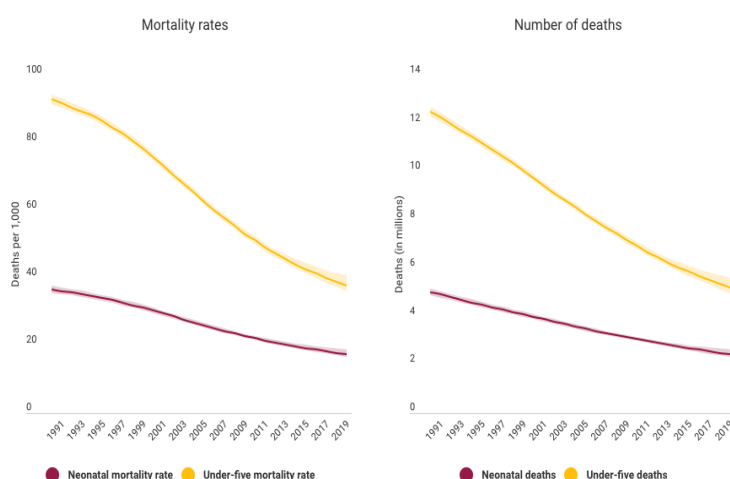
Table 2. 5 Top 10 countries with the highest number of neonatal deaths 2019

Country	Newborn deaths (in thousands)
India	522
Nigeria	270
Pakistan	248
Ethiopia	99
Democratic Republic of the Congo	97
China	64
Indonesia	60
Bangladesh	56
Afghanistan	43
United Republic of Tanzania	43
Source: (World Health Organization 2019b)	

Table 2. 6 Top 10 countries with the highest number of children under-five deaths 2019

Country	Under-five deaths (UI) (in thousands)
Nigeria	858 (675 – 1118)
India	824 (738 – 913)
Pakistan	399 (343 – 465)
Democratic Republic of the Congo	291 (187 – 440)
Ethiopia	178 (146 – 216)
China	132 (116 – 152)
Indonesia	115 (97 – 139)
United Republic of Tanzania	103 (78 – 172)
Angola	93 (43 – 172)
Bangladesh	90 (82 – 99)
Source: (World Health Organization 2020c)	

Figure 2. 2 Global neonatal and under-five mortality rates and number of deaths, 1990-2019



Source: Based on United Nations Inter-agency Group for Child Mortality Estimation (UN IGME) 2020.

Neonatal mortality is particularly of concern, globally and in Indonesia, as the decline of neonatal mortality has been slower than the decline of under-five mortality (United Nations 2016a). As shown in Figure 2.2, between 1990 and 2019, the global average annual rate of reduction for neonatal mortality rate was around 2.5%, which was smaller than the reduction in the mortality

rate for children aged 1-59 months at 3.6% (UN IGME 2020). In effect, a larger proportion of total under-five mortalities occurred during the neonatal period, increasing from 36% in 2010 to 47% in 2019 (United Nations 2016a; World Health Organization 2020d).

Furthermore, studies have shown that the early neonatal period (i.e. within the first week) is the most critical period for child survival (Lawn et al. 2005; Ngoc et al. 2006; Lehtonen et al. 2017). Of almost 5.3 million children under-five who died in 2019 (United Nations IGME 2020), 36% died within the first 24-hours of life and 73% died within the first week. Further, a study analysing six LMICs showed that the proportion of neonatal deaths that occurred within the first 24-hours following a live birth was around 46.3%, ranging from 36.2% in Pakistan to 65.5% in the United Republic of Tanzania (Baqui et al. 2016).

The magnitude of neonatal mortality may also be underestimated due to data reliability issues pertaining to reporting and recording of births and deaths. Previous studies have identified that neonatal deaths that occurred in the early period of births are more likely to be misclassified as stillbirths (Lawn et al. 2005, 2010). Based on a report by the WHO, underreporting may also occur due to the tedious process of death registration as well as misunderstanding of the definitions of neonatal deaths (World Health Organization 2006). Previous studies also showed that underreporting of neonatal deaths was more likely among births with very low birth weight (Greb, Pauli & Kirby 1987; Harter, Starzyk & Frost 1986). In the Indonesian context, as Kosen pointed out, there could be around 40% of underreporting of deaths in Indonesia (Kosen 2015).

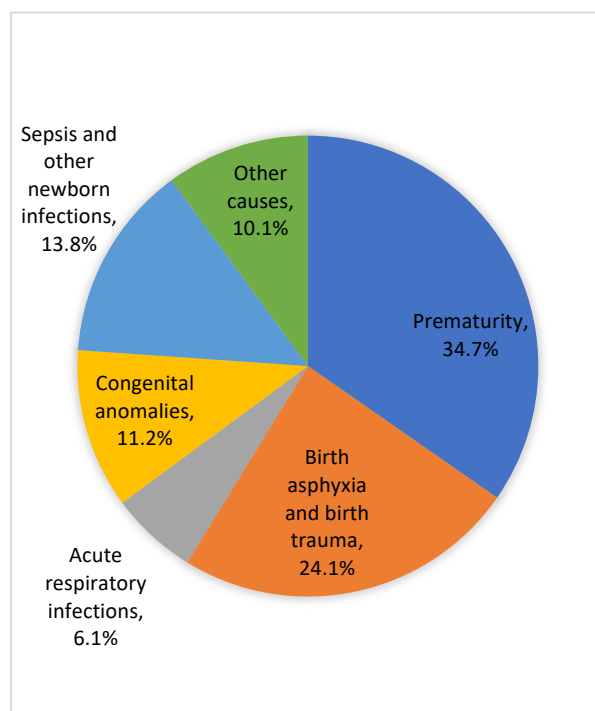
2.4 Causes of child mortality

As the causes of child mortality varied depending on the period during and after delivery, this section follows the classification by the WHO and distinguished between the neonatal (0-28 days) and post-neonatal periods (1-59 months) (World Health Organization 2020d).

2. 4. 1 Main causes of neonatal mortality

As seen from Figure 2.3, the major causes of neonatal mortality are complications due to prematurity (34.7%), birth asphyxia and birth trauma (24.1%), and sepsis and other infectious conditions of the newborn (13.8%) (World Health Organization 2020d). Other direct causes include congenital anomalies (11.2%) and acute respiratory infections (6.1%). However, the relative contributions of these causes of neonatal deaths vary across countries (Lawn et al. 2010, 2005). In countries with high neonatal mortality rates, the main causes of deaths in the neonatal period are infections and asphyxia, while for countries with low rates, complications or preterm birth and congenital anomalies predominate (Ngoc et al. 2006; Zupan 2005).

Figure 2. 3 Global causes of neonatal deaths, 2017



Source: WHO (2020d)

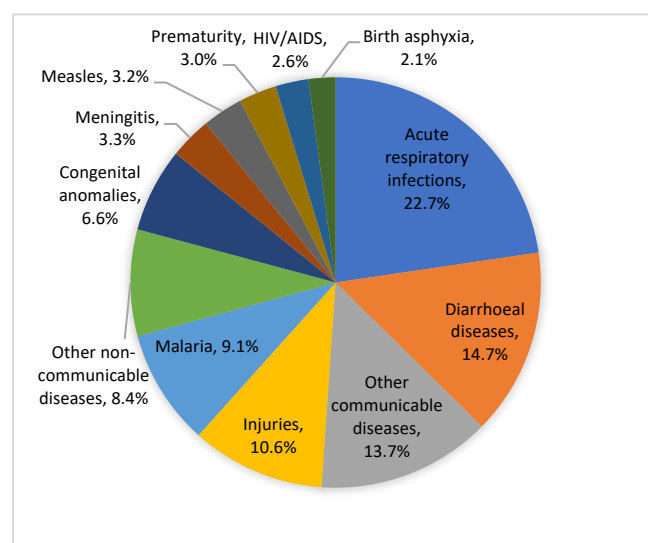
Neonatal infections such as sepsis, pneumonia, diarrhoea, and tetanus, are mainly attributable to the lack of quality maternal care in the periods before and during pregnancy, labour, and immediately after birth (Lawn et al. 2005; Goldenberg & McClure 2018). Appropriate hygiene during delivery and umbilical cord care, antibiotic treatment, exclusive breastfeeding, and tetanus vaccination are all essential in preventing early neonatal deaths. Further, intrapartum-related deaths or deaths during the delivery period, are also related to complications during delivery and childbirth, which account for around one-third of early neonatal deaths globally (Lawn, Shibuya & Stein 2005; Wall et al. 2010).

There has also been a shift in the causes of neonatal deaths, including in LMICs and countries with high neonatal mortality rates. Between 2000 and 2017, the newborn survival rate has increased and there have been lower newborn infections, but the proportion of prematurity-related deaths as well as congenital anomalies increased (Hug et al. 2019). This implies that preventing neonatal deaths due to prematurity as well as congenital anomalies would help further reduce neonatal mortality rates, including in LMICs. However, in LMICs, there are still limited interventions that currently address these causes.

2. 4. 2 Main causes of post-neonatal mortality

As seen in Figure 2.4, the major causes of post-neonatal deaths are acute respiratory infections (22.7%), diarrhoeal diseases (14.7%), other communicable diseases (13.7%), and injuries (10.6%) (World Health Organization 2020d). Other causes for post-neonatal mortality include other non-communicable diseases (8.4%), congenital anomalies (6.6%), prematurity (3.0%), and birth asphyxia (2.1%). Specific childhood infections that are prevalent in many LMICs, including Indonesia, also account for a notable proportion of the causes of post-neonatal deaths, including malaria (9.1%), meningitis (3.3%), measles (3.2%), and HIV/AIDS (2.6%).

Figure 2. 4 Global causes of post-neonatal deaths, 2017



Source: WHO (2020d)

In LMICs, infectious diseases such as pneumonia, diarrhoea, and malaria remain the leading causes of death for the post-natal period (Liu et al. 2012; Black et al. 2010; Fadel et al. 2017). These conditions are mainly attributable to basic life-saving interventions, particularly postnatal care, adequate childhood nutrition and breastfeeding practices, vaccinations, and proper treatment of childhood infections such as oral rehydration therapy and antibiotic prescriptions (Bhutta et al. 2013).

Child nutrition is particularly important in LMICs, as undernutrition is prevalent and has contributed to a higher risk of deaths from common childhood diseases such as diarrhoea, pneumonia, and malaria (Konadu et al. 2019; World Health Organization 2014; Rudan et al. 2013). Further, based on previous studies, vaccination efficacy in malnourished children is significantly lower, and thus, malnourished children would be more likely to be unprotected against vaccine-preventable illnesses (Chisti et al. 2015; Saleem et al. 2015; Prendergast 2015).

In Indonesia, 30.5% children under-five were stunted in 2018 (UNICEF, World Health Organization & World Bank 2019). Stunting is a result of chronic malnutrition and repeated infections during childhood such as repeated diarrhoeal diseases or pneumonia infections. Stunted children experience growth and developmental failure and would permanently limit the children's physical and cognitive capacity. Based on the WHO definition, a child is stunted if their height-for-age measurement falls below two standard deviations of the WHO Child Growth Standards median (World Health Organization 2009). Acute malnutrition

or underweight as measured using weight-for-age of the child, is also prevalent among Indonesian children under-five years of age at 17.7% in 2018. The prevalence of both stunting and undernutrition in Indonesia is higher than neighbouring countries such as Vietnam (24.6% and 14.1% for stunting and undernutrition, respectively), Malaysia (20.7% and 12.4%), and Thailand (10.5% and 6.7%).

2.5 Interventions to reduce maternal and child mortality

2.5.1 Interventions to prevent and treat major causes of maternal mortality

Clinical interventions that are proven to be effective to prevent or treat the main causes of maternal deaths are summarised in Table 2.7. The summary is based on a publication by Gülmezoglu et al. (2016) that assessed existing clinical evidence from various trials and Cochrane reviews. While the level of evidence on the clinical safety and efficacy of these interventions is well established, the coverage levels of the interventions are largely unknown. Estimates are usually drawn from national health information systems if available, or by using proxy indicators from survey data.

Homer et al. (2014) estimated that the interventions outlined in table 2.7 would occur in 20% of deliveries with a skilled birth attendant in most LMICs, unless the delivery occurred in a facility that provides Comprehensive Emergency Obstetric and Neonatal Care (CEmONC) services. In which case, the assumption was 95% of women would receive the appropriate treatment. This highlights that most of the interventions depend on both the availability of well-trained health professionals and facilities that are well-equipped for emergency obstetric care (Bhutta et al. 2013). Primary health facilities can also be equipped to provide Basic Emergency Obstetric and Neonatal Care (BEmONC), which delivers basic essential emergency care for pregnant women and newborns.

Table 2.7 Clinical interventions to prevent and treat major causes of maternal deaths

Causes and global burden of maternal mortality (%)	Type of intervention	Level of health care facility required
Postpartum haemorrhage (>25%)	- Anaemia prevention in pregnant women - Uterotonics administration - Oxytocin & misoprostol - Uterine massage - Compression balloon tamponade - Fluid resuscitation - Blood transfusion - Surgery	Primary non-BEmONC Primary BEmONC Primary BEmONC Primary BEmONC Primary BEmONC Primary BEmONC Secondary CEmONC Secondary CEmONC
Sepsis (6-19%)	- Infection-control procedures - Prophylactic antibiotics - Antibiotics administration	Primary non-BEmONC Primary BEmONC Primary BEmONC

Pre-eclampsia/eclampsia (11-17%)	• Routine measurement of blood pressure • Calcium supplementation • Low dose aspirin • Magnesium sulphate • Timely identification of danger signs • Magnesium sulphate • Delivery	Primary non-BEmONC
Unsafe abortion (5-13%)	• Contraception • Access to safe and legal abortion services • Treatment of haemorrhage and infection • Surgical procedures	Primary non-BEmONC Secondary CEmONC Secondary CEmONC
Obstructed labour (4-13%)	• Monitoring the progress of labour (partograph) • Manoeuvres for shoulder dystocia • Vacuum and forceps delivery • Caesarean section • Symphysiotomy	Primary non-BEmONC Primary BEmONC Primary BEmONC Secondary CEmONC Secondary CEmONC
Source: (Gülmezoglu et al. 2016)		

While most of the interventions included in the Table 2.7 relate to skilled birth attendance and emergency obstetric care, the most cost-effective intervention is the family planning program accompanied by safe abortion services. According to several studies in LMICs, increasing the coverage of contraceptive use could prevent 1 in 3 pregnancy-related deaths in Afghanistan (Carvalho, Salehi & Goldie 2013), avert 7,000 newborn and child deaths in South Africa annually (Chola et al. 2015), and prevent more than 150,000 maternal deaths in India (Goldie et al. 2010). More specifically, Goldie et al. (2010) found that if the need for birth spacing and limiting was met over a 5-year period, more than USD1 billion would be saved and at least this would prevent one every two abortion-related deaths.

Hence, it is interesting that the initial introduction of family planning services at the global level was associated with an increased MMR. This is because the segment of the population who first adopt contraception are usually the more educated, who have a lower risk of maternal death (Karlsen et al. 2011). This means a decrease in the number of births (the denominator for MMR) but the number of maternal deaths (the numerator for MMR) does not decrease in the same proportion, and thus, resulting in an initial apparent increase in the MMR. The overall MMR decreased only after the family planning services reach a much larger population and reach women with the highest risk of maternal deaths. These include women of older age, who have high parity and have pre-existing conditions that increase the risk of maternal deaths. Therefore, improving the family planning programs requires interventions that are geared towards these high-risk groups.

It is obvious that low coverage of contraception leads to a higher number of unwanted pregnancies. Even in countries with restrictive access and laws, women who are more affluent and educated would be more likely to have access to safe abortion (Ganatra &

Faundes 2016). However, unsafe abortions persist due to barriers such as legal and policy restrictions, service delivery issues including provider attitudes as well as the stigma surrounding abortion. Such issues are prevalent in many LMICs and have led to unsafe abortion practices that have in turn led to higher maternal mortality and morbidity (Makenzius et al. 2019; Chemlal & Russo 2019; Goldie et al. 2010), including in Indonesia (Situmorang 2003; Nasir 2011).

2. 5. 2 Interventions to prevent and treat major causes of child mortality

Newborn mortality is mainly caused by intrapartum-related complications (59%) (Liu et al. 2016) and the leading cause of all under-five deaths is now preterm birth (Bhutta et al. 2014). Thus, many interventions for reducing neonatal deaths relate to obstetric care including skilled birth attendants, neonatal resuscitation that is part of the CEmONC services, and caesarean section. Previous studies have found that universal coverage of skilled delivery care and access to CEmONC services are estimated to reduce neonatal deaths by 45% (Darmstadt et al. 2005).

The majority of neonatal deaths are also avoidable with low technology and low-cost interventions (Darmstadt et al. 2005). These include proper hygiene during birth and umbilical cord care to prevent neonatal sepsis and other newborn infections; identification and referral of cases that require emergency care; and antenatal examinations to detect any congenital anomalies and other intrapartum conditions that may increase the risk of neonatal complications (Darmstadt et al. 2005). However, there is room to improve the quality of antenatal care, as noted by studies showing that many of the essential ANC components were not delivered adequately in LMICs (Hodgins & D'Agostino 2014; Amouzou et al. 2019). Other interventions during pregnancy (such as tetanus immunisation and intermittent preventive treatment for malaria) are also important in reducing neonatal mortality, but to a lesser degree compared to care during childbirth and postnatal care (Blencowe et al. 2010; Wall et al. 2010; Baqui et al. 2016). Reducing unwanted pregnancies, ensuring essential nutrition, and treatment of sexually transmitted diseases before pregnancy also reduce the risk of adverse maternal and newborn outcomes (Lawn, Shibuya & Stein 2005; Liu et al. 2012).

Table 2. 8 Clinical interventions to prevent and treat major causes of child deaths

Causes and global burden of child mortality (%)	Type of intervention	Level of health care facility required
Neonatal period		
Prematurity (35%)	• Antenatal corticosteroid to improve newborn outcomes • Tocolytics for preventing preterm labour • Magnesium sulphate for foetal protection against neurological complications • Antibiotics for preterm labour • Thermal care (kangaroo mother care, radiant warmers or in incubators) • Continuous positive airway pressure for newborns with respiratory distress syndrome • Management using surfactant for newborns with respiratory distress syndrome • Oxygen therapy	Primary non-BEmONC for kangaroo mother care Others: Primary BEmONC & secondary CEmONC
Birth asphyxia & trauma (24%)	• Neonatal resuscitation • Oxygen therapy • Continuous positive airway pressure for newborns with respiratory distress syndrome	Primary BEmONC Primary BEmONC Secondary CEmONC
Sepsis and other newborn infections (14%)	• Parenteral antibiotics	Primary BEmONC
Post-neonatal period		
Acute respiratory infections (23%)	• Prevention: general hygiene, hand washing, exclusive breastfeeding, prevention of indoor air pollution • Recognition of problems, illness and timely care-seeking • Antibiotic • Immunisation	Community-level Community-level, primary Primary non-BEmONC
Diarrhoeal diseases and other vaccine-preventable infections (35%)	• Prevention: general hygiene, hand washing, exclusive breastfeeding, immunisation, micronutrient supplementation (including zinc and vitamin A) • Recognition of problems, illness and timely care-seeking • Integrated management of diarrhoea, pneumonia, fever, uncomplicated severe acute malnutrition (IMCI) • Antibiotic treatment for bacterial diarrhoea	Community-level Community-level, primary Community-level, primary Primary non-BEmONC
Malaria (9%)	• Insecticide-treated bed nets • Intermittent preventive treatment for malaria in pregnancy • Antimalarial treatment	Community-level Primary non-BEmONC Primary non-BEmONC
Source: (World Health Organization 2010a, 2015a; Lassi et al. 2014)		

Reductions in under-five mortality have largely resulted from successful programs aimed to prevent and treat childhood infectious diseases that cause the major burden of child mortality, such as diarrhoea, malaria, pneumonia, and other vaccine-preventable infections (Fadel et al. 2017; Martines et al. 2005). Community-based programs have also been successful in preventing and treating childhood infections, including insecticide-treated bed nets to prevent malaria infection, oral rehydration therapy at home to manage child diarrhoea, and vaccination. On the other hand, addressing neonatal mortality through interventions such as skilled birth attendance, BEmONC, and CEmONC services, demands access to quality care that is supported by well-functioning health systems that integrate essential newborn care into existing maternal and child health programs (Kerber et al. 2007).

2.6 Inequalities in maternal and child mortality in LMICs

Pro-rich inequities in maternal and child mortality have been widely documented in some LMICs (Randive et al. 2013; Wagstaff 2000; Hodge et al. 2014; Ronsmans, Graham & Lancet Maternal Survival Series steering group 2006; Lawn et al. 2005; Lehtonen et al. 2017). A study that looked at infant and under-five mortality in nine LMICs found that in 8 out of 9 countries, the poorest quintile suffered higher infant and under-five mortality than any other wealth quintiles (Wagstaff 2000). The study also found large gaps between the bottom and the highest wealth quintile. For instance in Brazil, with a national IMR at 43.2 per 1,000 live births, the IMR for the poorest quintile was 72.7 per 1,000 live births compared to 17.0 among children in the richest quintile. Studies from Indonesia have also documented that households from the richest wealth quintile had lower neonatal and under-five mortality rates compared to poorer households (Hodge et al. 2014). A more recent WHO report on Indonesia stated that the poorest to richest ratio were 3.0 for NMR, 3.1 for IMR, and 3.2 for U5MR Indonesia (World Health Organization 2017).

Geographical variations in maternal and child mortality in LMICs are also notable. Previous studies have documented rural-urban disparities in terms of maternal and child mortality with the highest burden of deaths in the rural population (Liang et al. 2011; Atuoye et al. 2015; Hanson et al. 2015; Houweling et al. 2006). Ronsmans et al., (2003) found that maternal mortality in rural areas of West Africa was 601 per 100,000 live births compared to 241 in urban areas. They drew the implication that the difference was due to access to quality maternity care. In their study assessing preventable maternal mortality in China, Liang et al. (2011) found that 86.1% of deaths were preventable, with higher risk of preventable maternal deaths found in rural areas (2.79) compared to urban areas (2.38). The risk was also higher for remote areas (4.8) as well as coastal areas of China (4.7) compared to the mainland regions. The study also looked at the possible causes of variations in preventable maternal mortality, which included the variability in the substandard obstetric services in the remote areas and low health knowledge among pregnant women.

In Indonesia, rural child mortality rates were about 1.5 times higher compared to urban areas (World Health Organization 2017). More specifically, rural to urban ratio for NMR and IMR was 1.6 and for U5MR was 1.5. Within country regional differences were also apparent for maternal mortality. In the less developed region of Papua province, for instance, the MMR was 380 deaths per 100,000 live births, which was significantly higher than the national average of 177 per 100,000 live births (National Population and Family Planning Board (BKKBN) et al. 2018; World Health Organization 2020a).

2.7 Summary

While progress has been made in reducing maternal and child mortality, the global burden is still significant. The majority of deaths occur in LMICs and Indonesia has one of the highest rates of maternal and child deaths within the Southeast Asia region. Despite broad international consensus on the interventions needed to address maternal and child mortality, essential services have not reached many of the women and children that need them most. Inequality in maternal and child deaths is apparent, particularly between different income groups and geographical locations. Lack of skilled personnel and health facility readiness as well as factors such as malnutrition and the growing prevalence of NCDs are likely to hinder the progress in reducing maternal and child mortality.

Chapter 3: Context of Indonesia

Chapter Three describes the geography and demographics of Indonesia, and reviews the health system with a particular focus on maternal and child health programmes. The chapter also provides an overview of the evolution of the Indonesian health insurance system with a section on policies that remove financial barriers to accessing maternal and child health services.

3.1 Geography and demography

Indonesia is a Southeast Asian country and the largest archipelago in the world with 16,056 islands located between the Pacific and the Indian oceans (Central Bureau of Statistics 2019). Based on the size of land area, Indonesia is the 14th largest country at 1,916,862 square kilometres. From east to west, Indonesia extends 5,120 kilometres and 1,760 kilometres from north to south. Indonesia shares borders with East Timor, Papua New Guinea, and Malaysia and bridges two continents, Asia and Australia. Indonesia's geography consists of five main islands, i.e. Sumatra Java/Madura, Kalimantan, Sulawesi and Papua.

The country's administrative government is comprised of 34 provinces, 98 municipalities, and 416 districts that are divided into 7,094 sub-districts and 83,931 villages (Central Bureau of Statistics 2019). Jakarta is the nation's capital city and is located in the Java island.

Indonesia's terrain is mainly coastal with mountain areas in some of the larger islands with a tropical climate and high humidity.

Figure 3. 1 Indonesia map



Source: Wikipedia, 2020

The estimated Indonesian population in 2020 is around 269 million (Central Bureau of Statistics 2018b) making it the fourth largest country in the world after the Republic of China, India and the United States of America. Indonesia's annual population growth in 2019 was 1.1%, a decrease from 1.34% in 2010. However, the current annual population growth is high compared to the average of other LMICs in Asia and the Pacific (0.7%) (World Bank

2020a). The population is projected to grow to around 305 million by 2035. The proportion of Indonesia's urban population has been on the rise, from 42.0% in 2000 to 55.9% in 2019 (World Bank 2020b). The most populous islands are Java and Bali, which make up around 58.1% of the total population, followed by Sumatra (21.8%), Sulawesi (7.3%) and Kalimantan (6.1%). The eastern Indonesia region contains fewer inhabitants such as in Maluku and North Maluku (1.1%) as well as Papua and West Papua (1.6%). The population density also varies across the different regions in Indonesia, from 15,764 people per square kilometre in the capital city of Jakarta to only 9 in West Papua province (Central Bureau of Statistics 2019).

Indonesia's population is multiethnic with a large number of cultural and linguistic groups, speaking around 724 languages and dialects. Since its independence in 1945, the national language, Bahasa Indonesia, has been widely used in education, business and government affairs as well as in most written communications. There are 15 largest ethnic groups that form around 84.9% of the total population (Ananta et al. 2013). The remaining ethnic groups consist of 619 small ethnic groups. Javanese is the largest ethnic group that makes up around 40.0% of the total population, followed by Sundanese, Malay, Batak and Madurese. The smaller ethnic groups and subgroups particularly originate from the eastern part of Indonesia. For example, Papua region has around 263 very small ethnic sub-groups using different languages and dialects. Based on the population census in 2010, 87.2% of the population identified themselves as Muslim, 6.9% as Protestant, 2.9% as Catholic, 1.7% as Hindu, 0.7% as Buddhist and 0.6% as others (Central Bureau of Statistics 2011).

3.2 Health status

Indonesia has made significant progress in important population health indicators including in life expectancy, maternal and child health as well as in the populations' general health status (Table 3.1). Indonesia life expectancy at birth has increased significantly, from 63.2 in 1990 to 71.7 in 2019. However, this figure is slightly below the average for the Asian region (73.6) and compared to other Southeast Asia countries including Malaysia (76.2) and Vietnam (75.4). Further, as explained in Chapter Two, Indonesia's relatively poor performance in reducing maternal and child mortality has contributed to the lower life expectancy outcome compared to other Asian countries.

Further, there is significant inequity in the maternal and child health outcome indicators across regions within Indonesia. For instance, the 2012 MMR for the most eastern part of Indonesia (Papua province) was significantly higher than the national average at 573 compared to 210 per 100,000 live births (Bureau of Statistics Indonesia et al. 2013). Further information on the socioeconomic and geographical inequalities in maternal and child health care service use and outcomes is detailed in sections below.

Table 3. 1 Indonesia health indicators, selected years

Health indicators	2000	2005	2010	2015	2019
Life expectancy at birth (years)*, total	65.8	67.3	69.2	70.8	71.7
Life expectancy at birth (years)*, female	67.2	69.1	71.3	72.9	73.7
Life expectancy at birth (years)*, male	64.3	65.6	67.2	68.7	69.4
Neonatal mortality rate* (per 1,000 live births)	22.8	19.8	17.4	14.5	12.4
Infant mortality rate* (per 1,000 live births)	41.0	33.6	28.0	23.3	20.2
Under-five children mortality rate* (per 1,000 live births)	52.2	41.7	33.9	27.8	23.9
Maternal mortality ratio* (per 1,000 live births)	272	252	228	192	177**

Source: (World Bank 2020c)

Note: * UN modelled estimates; ** 2017 data

3.3 The health system in Indonesia

3.3.1 Overview of the health care system for maternal and child health

Organisation

After the decentralisation of the government system took place in 1999, the Indonesian health services were decentralised to provincial and district levels. This consisted of decentralisation of some responsibilities in planning, budgeting and managing health service delivery from the central-level Ministry of Health to the provincial and district level governments. At the central level, the Ministry of Health (MoH) is responsible for providing strategic health directions, setting standards and regulations, managing some tertiary and specialist hospitals, as well as ensuring the availability of financial and human resources (Mahendradhata et al. 2017). Provincial governments are responsible for the planning and budgeting of provincial health services, provision of technical oversight and monitoring the district-level health service performance, coordinating the cross-district health management as well as in the management of provincial hospitals. District/municipal-level governments are responsible for planning and budgeting for health services at the district and sub-district levels, managing district-level hospitals as well as public primary health centres and all corresponding subdistrict health facilities.

Figure 3.2 provides an overview of the organisation of the Indonesian health system. The decentralisation of the health system means that the relationship between the MoH, provincial health office (PHO) and district/municipality health office (DHO) is not hierarchical. Each level of the government has its own authority and mandates. The DHO for instance, does not directly answer to the PHO but to the head of district. Further, PHO is not responsible to the MoH, but instead to the provincial governor. Both provincial and district level governments directly answer to the Ministry of Home Affairs. However, several vertical programs are planned and budgeted directly by the MoH and function at the district and

provincial levels. These programs include childhood immunisation, HIV/AIDS, tuberculosis and malaria.

At the central level, there are several departments outside of the MoH that play important roles in health service provision, as follows:

- The National Population and Family Planning Board that manages all family planning-related programs, including coordinating the community-level outreach for family planning services, providing subsidised contraceptive methods through Puskesmas and public hospital as well as conducting monitoring and evaluation of various family planning programs.
- The Social Security Agency (*Badan Pelaksana Jaminan Sosial-Kesehatan* or BPJS-K), which is the parastatal institution that manages the National Health Insurance program. BPJS-K is mandated to manage membership and collect insurance premiums, administer contracts with both public and private health service providers at the primary and secondary health service level and finally, provider payment. BPJS-K sits at the national level with regional offices at the district and provincial levels. BPJS-K answers directly to the President with a coordination line between the MoH and Ministry of Finance (MoF).
- Food and Drug Control Agency (*Badan Pengawasan Obat dan Makanan* or BPOM). BPOM was originally part of the MoH, however, with its growing role in food and drug monitoring, it was established as a separate entity from the MoH in 2011 and serve as an independent board directly under the president.

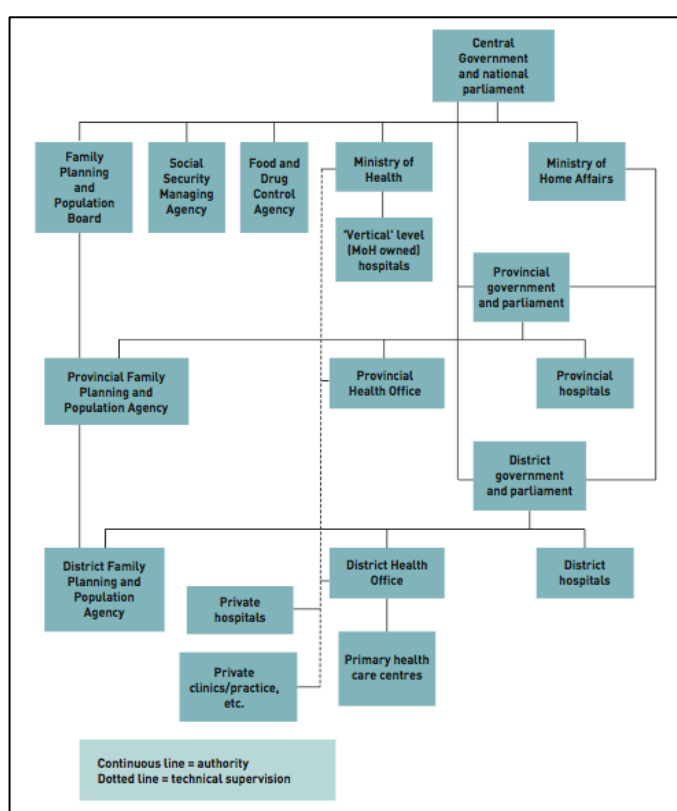


Figure 3. 2 Organisation of health system in Indonesia

The Indonesian health system is a mixture of public and private providers and financing. From a total of 2,344 hospitals in Indonesia, 1,384 hospitals (59.0%) are privately owned (Indonesia MOH 2020). However, the size of these private hospitals is relatively smaller compared to public hospitals and they contribute to around 46.4% of total hospital beds. Primary health services within the public sector are mainly delivered through community health centres (*Pusat Kesehatan Masyarakat* or Puskesmas). There are 10,134 Puskesmas across 34 provinces in Indonesia.

Source: Mahendradhata et al. (2017)

The Puskesmas is also responsible to manage community health and is supported by a network of health services, consisting of auxiliary Puskesmas (*Puskesmas pembantu* or Pustu) at the village level. Pustu is usually utilised as the centre for community outreach for health promotion and prevention programs as well as some MNCH services including family planning program, antenatal care and childhood immunisation (Mahendradhata et al. 2017). And within the private sector, there are 7,917 primary clinics, which are mainly run by doctors or nurses and or joint GP practice.

3.3. 2 Human resources for health

Indonesia has made a significant investment in human resources for health. The ratio of medical personnel per 1,000 population has increased over the last three decades; physicians ratio from 0.15 in 1992 to 0.4 in 2018; nurse ratio from 0.52 to 2.4 and midwife ratio from 0.12 to 2.4 within the same period (Mahendradhata et al. 2017; World Health Organization 2020e, 2020f). However, there are several key issues related to human resources for health in Indonesia.

First is the absolute number of medical personnel available to serve the population, in particular the number of physicians. While the ratio to population has increased over the decades and the fact that Indonesia produces around 6,000 new physicians every year, the ratio per 1,000 population is still far below the government target, which was 0.5 in 2019. The availability of the health workforce in Indonesia is also lower than in other Southeast Asia countries. On average, Indonesia has 0.4 doctors per 1,000 population, which is lower than Malaysia (1.5), the Philippines (0.6), Thailand (0.8), Vietnam (0.8) as well as the average ratio for LMICs (1.2) (World Health Organization 2020e). The availability of nurses and midwives is at 2.4 per 1,000 population, which is similar to the average of LMICs (2.5) but lower than Malaysia (3.5) and the Philippines (4.9).

The second issue is the distribution of health personnel across within the country. According to the latest data from the MoH, 62.5% of medical personnel were located in Java-Bali region (where 59.1% of the population reside), particularly in large provinces in Java island such as Jakarta, East Java and Central Java (Indonesia MOH 2020). However, less densely populated provinces have much fewer health personnel, including provinces in Kalimantan, Sulawesi and the Eastern Indonesia. As seen from table 3.2, provinces with the highest ratio of physicians per 100,000 population were Jakarta (207.2), Yogyakarta (128.5) and Bali (121.2), all three provinces are located in Java-Bali region. While using the ratio of health workers to population is useful for planning for health resources, a high ratio to population does not necessarily lead to better access to health services. This is particularly the case for Indonesia regions with a large landmass and low population density, which results in limited geographical access to health services.

As seen from Table 3.2, Papua province for instance, has quite high doctors to 100,000 population ratio at 32.4. However, its ratio of doctors to 1,000 kilometre square is

extremely low at 3.4 compared to other more developed provinces such as Jakarta (32,660), Yogyakarta (1,559), and Bali (899). Similarly, its midwives and Puskesmas ratio to geographical size is one of the lowest in the country. This creates physical barriers in accessing services in provinces like Papua.

The competence level of health care workers also varies across regions. For instance, Rokx et al. (2010) found that public health providers in Java-Bali region scored higher in terms of providing antenatal care according to clinical standards compared to health care workers in other provinces. This was also the case for child curative care. This means that in addition to challenges in mobilising health workers to less-developed regions, the competence of the existing health providers in these areas is comparably lower than in well-developed regions.

Table 3. 2 Human resource for health availability by Indonesian provinces, 2018

No.	Province	Absolute number			Per 100,000 population			Per 1,000 kilometre square		
		Medical staff	Midwife	Puskesmas	Medical staff	Midwife	Puskesmas	Medical staff	Midwife	Puskesmas
1	Aceh	3,915	11,252	348	74.1	213.1	6.6	67.6	194.1	6.0
2	North Sumatra	11,608	17,665	581	80.5	122.5	4.0	159.1	242.0	8.0
3	West Sumatra	3,735	5,658	275	69.4	105.1	5.1	88.9	134.7	6.5
4	Riau	4,298	6,741	216	63.1	98.9	3.2	49.4	77.5	2.5
5	Jambi	1,868	5,286	195	52.3	148.1	5.5	37.3	105.6	3.9
6	South Sumatra	4,069	11,159	332	48.6	133.3	4.0	44.4	121.8	3.6
7	Bengkulu	936	3,821	180	47.7	194.6	9.2	47.0	191.8	9.0
8	Lampung	2,916	7,691	302	34.8	91.9	3.6	84.2	222.1	8.7
9	Bangka Belitung Islands	573	1,402	64	39.2	96.0	4.4	34.9	85.4	3.9
10	Riau Islands	1,253	1,761	83	58.6	82.4	3.9	152.8	214.7	10.1
11	Jakarta	21,687	8,318	321	207.2	79.5	3.1	32660.7	12526.9	483.4
12	West Java	22,929	17,645	1069	47.1	36.2	2.2	648.1	498.8	30.2
13	Central Java	14,620	23,490	881	42.4	68.1	2.6	445.7	716.1	26.9
14	Yogyakarta	4,886	2,445	121	128.5	64.3	3.2	1559.5	780.4	38.6
15	East Java	19,377	25,140	967	49.1	63.6	2.4	405.4	525.9	20.2
16	Banten	7,267	5,181	242	57.3	40.8	1.9	752.1	536.2	25.0
17	Bali	5,201	4,583	120	121.2	106.8	2.8	899.8	792.9	20.8
18	West Nusa Tenggara	1,495	6,921	166	29.8	138.0	3.3	80.5	372.7	8.9
19	East Nusa Tenggara	1,010	5,166	381	18.8	96.2	7.1	20.7	106.0	7.8
20	West Kalimantan	1,491	4,037	244	29.8	80.7	4.9	10.1	27.4	1.7
21	Central Kalimantan	939	3,476	200	35.3	130.7	7.5	6.1	22.6	1.3
22	South Kalimantan	1,705	4,483	233	40.8	107.2	5.6	44.0	115.7	6.0
23	East Kalimantan	2,360	3,485	183	64.7	95.5	5.0	18.3	27.0	1.4
24	North Kalimantan	290	983	56	40.5	137.2	7.8	3.8	13.0	0.7
25	North Sulawesi	3,010	1,694	193	121.2	68.2	7.8	217.3	122.3	13.9
26	Central Sulawesi	938	5,079	202	31.2	168.7	6.7	15.2	82.1	3.3
27	South Sulawesi	5,714	9,299	458	65.1	106.0	5.2	122.3	199.0	9.8
28	Southeast Sulawesi	729	4,175	284	27.5	157.3	10.7	19.2	109.7	7.5
29	Gorontalo	368	1,472	93	31.0	124.2	7.8	32.7	130.8	8.3
30	West Sulawesi	174	1,426	94	12.8	105.2	6.9	10.4	84.9	5.6
31	Maluku	529	1,604	208	29.8	90.4	11.7	11.3	34.2	4.4

	Province	Absolute number			Per 100,000 population			Per 1,000 kilometre square		
No.		Medical staff	Midwife	Puskesmas	Medical staff	Midwife	Puskesmas	Medical staff	Midwife	Puskesmas
32	North Maluku	267	1,720	134	21.7	139.5	10.9	8.3	53.8	4.2
33	West Papua	321	1,016	159	34.2	108.4	17.0	3.2	10.2	1.6
34	Papua	1,076	2,452	408	32.4	73.8	12.3	3.4	7.7	1.3
	Indonesia	153,554	217,726	9,993	57.9	82.2	3.8	80.2	113.8	5.2

Several key policies were put in place to address the health workforce issues. One policy that was directly designed to address maternal health burden is the village midwife program (*Bidan di Desa*). The program was established in 1989, following the launch of the global Safe Motherhood Initiative. The program aimed to replace the widespread practice of using traditional birth attendants (TBA) by providing better and more direct access to trained health care providers (Shankar et al. 2008; Shrestha 2010; Titaley, Dibley & Roberts 2011). This was done through an ambitious target to equip each and every village across Indonesia with a well-trained midwife, stationed at a small village birthing facility (*Pos Bersalin Desa* or Polindes). The village midwife program is also an integral part of the Posyandu, which holds monthly community health meetings. And thereby, the village midwife would have the opportunity to routinely administer maternal and child health services every month to the village community, including antenatal services, reproductive health consultations and postnatal care. In order to facilitate outreach health services, community health volunteers (CHV) are engaged in every village to help assist health promotion programs, including maternal and child health.

In order to meet its target of having every village equipped with a midwife, the village midwife programme was set to deploy 54,000 midwives within 7 years, an effort that demanded enormous political and financial commitment (Shiffman 2007). By 1997, 96% of the Indonesian population had access to the 54,000 midwives deployed to villages (Indonesia MOH 1998). Between 1986 and 1996, the overall midwife-to-population density also increased from 0.2 to 2.6 per 10,000 population (Ministry of Health 2000). And between 1990 and 2003, the proportion of skilled birth attendance in rural areas increased from 22% to 55% (Central Bureau of Statistics Indonesia, National Population and Family Planning Board (BKKBN) & Calverton 2003; Central Bureau of Statistics, National Family Planning Coordinating Board (BKKBN) & Inc. 1992). The village midwife program also improved the nutritional status of women and children, as shown by studies conducted revealing an association between delivery by village midwives and reduction in early infant deaths (Frankenberg, Suriastini & Thomas 2005; SUMMIT Study Group 2008). However, the improvement in maternal and neonatal health outcomes following 20-years after the massive village midwife programme was deemed too slow (Shankar et al. 2008) with MMR in 2003 at 307 per 100,000 live births and NMR at 20 per 1,000 live births (Central Bureau of Statistics Indonesia, National Population and Family Planning Board (BKKBN) & Calverton 2003). Several issues that contributed to the slow progress in reducing the MMR and NMR following the village midwife programme have been identified.

First, the pressure to rapidly deploy a large number of midwives to the villages compromised the recruitment and training process. There was a lack of clinical training and field experience the midwives received prior to their deployment, leading to the limited ability in managing complications during pregnancy and delivery (Geefhuysen 1999; Ronsmans 2001). Second, there was inadequate supervision and clinical mentoring for the village midwife as the responsibility often falls to the head of the nearest Puskesmas, often

already overworked with Puskesmas duties. An antecedent to this was the long-term plan for the midwives to eventually establish their own private practices and that MoH salary and oversight was planned to be limited 3 years only. However, the training of the midwives did not cover skills for working in the community or client relationship. And thus, the ongoing lack of supportive supervision, unclear job descriptions and diverse responsibilities resulted in many village midwives working in isolation with limited career development and continuing their clinical education (Makowiecka et al. 2008). These factors also affected the retention of the village midwives.

The third issue was the limited access to and financial support for referring patients to emergency care facilities. Village midwives are not mandated nor trained to provide emergency care, but their remote location means that referral care should be an integral part of the programme as obstetric and neonatal complications significantly contributed to Indonesia's high MMR and NMR (Ronsmans 2001). However, while the density of midwives in Indonesia was similar to countries that have achieved reductions in maternal deaths such as Sri Lanka and Malaysia, it lagged in the density of doctors, nurses and referral facilities (Makowiecka et al. 2008). And finally, the Asian economic crisis in 1997 led to a substantial decline in Indonesia's health expenditure (Simms & Rowson 2003). The government decentralisation following the crisis also further diminished health spending as political and financial power devolved to the district level (Kristiansen & Santoso 2006).

The government had also introduced compulsory employment in the public sector for doctors, midwives and nurses for new graduates in the late 1960s. The new graduates had to serve at least two years in a remote or at least three years in a rural area or five years in urban areas (Rokx 2010). However, the policy was terminated due to the Asian financial crisis and changed into the *Pegawai Tidak Tetap* (PTT or contract staff) program. Under the PTT program, newly graduated doctors have to be contract staff in remote and rural areas. However, due to the high dissatisfaction level among the graduates, the program was terminated in 2007 and has since been reintroduced under a new scheme. The new scheme is not compulsory and operates under the decentralised health system where district and provincial health offices have autonomy in deciding the incentive amount and contract period. This resulted in wide variations of incentives across districts and provinces, from USD 500 to USD 2,500 per month. Districts or provinces with larger health budgets became more attractive for doctors to work at, leading to unequal distribution of specialists and general practitioners (GP). Additional incentives are provided by the Ministry of Health at up to USD 750 per month for specialist doctors and USD 500 for general practitioners (Meliala, Hort & Trisnantoro 2013).

The capacity of health education institutions in producing health workforce was also incentivised through various regulations and funding for health education schools (Rokx 2010). Between 2004 and 2008, there was a 17% annual increase in the production capacity of health education institutions. However, there is an over-supply of health workforce graduates in Java and limited supply in the more remote regions. For instance, out of 12,000

nurses who graduate annually in East Java province, only 10% were employed (Bappeda Provinsi Jawa Timur 2012). Further, out of a total of 89 medical schools in Indonesia, 40 are concentrated in the Java-Bali region, producing around 70% of the total graduates. On the other hand, regions such as Papua only has 2 medical schools, one of which has not been fully accredited by the Ministry of Education (Indonesian Medical Council 2020).

3.3.3 Health facilities

Primary health level

Within the public sector, primary health care services are delivered at the public health centre (*Pusat Kesehatan Masyarakat* or Puskesmas) and within the private sector at the private clinics as well as a GP practice. In 2019, there were 10,134 Puskesmas, of which 6,086 (60.0%) provided inpatient services (Indonesia MOH 2020). Puskesmas with inpatient beds are designed to be intermediate referral facilities for Puskesmas or private clinics without inpatient capacity.

Puskesmas are designed as the gatekeeper of health services and to provide access to care for the whole population. The majority of Puskesmas is located in the sub-districts and are supported by a network of smaller health facilities at the village level. Puskesmas are accountable to the district health office. Out of over 10,000 Puskesmas in Indonesia, three-quarters are in rural areas and 9.5% and 17% are classified as located in remote and very remote regions (Indonesia MOH 2020).

The main role of Puskesmas is to provide both public health service and curative care. There are 8 essential services that Puskesmas need to provide; (1) general health service; (2) reproductive, maternal and child health; (3) dental care; (4) pharmacy; (5) laboratory; (6) disease control and prevention; (7) consultation clinic and; (8) emergency health services. In addition to the essential health services, some Puskesmas also provide nutrition consultation, and basic obstetric and neonatal emergency services. However, only around 50% of Puskesmas provide the 8 essential services, 32% nutrition consultation and 18.6% for the BEmONC services (Indonesia MOH 2020).

Around 92.6% of the population has access to primary care, either through Puskesmas or private clinics. However, the level of access varies across regions and is influenced by factors including geographical location, the characteristics of the area and local regional development level. For instance, a province such as Jakarta has the highest ratio of Puskesmas to sub-districts at 7.7, which is significantly higher compared to West Papua province at 0.7 Puskesmas per sub-district (Indonesia MOH 2020). The level of accreditation of the Puskesmas, which indicates the readiness level to provide essential services, also varies across provinces. Only 28.6% of Puskesmas in Papua received good accreditation from the MoH compared to 100% of Puskesmas in more-developed provinces in the Java-Bali region. Therefore, the quality of services at Puskesmas level also varied.

Due to the limited availability of health workers in remote areas, particularly specialist doctors, task shifting is implemented in some rural or very remote Puskesmas by giving

additional training and authority for health workers to be able to perform several emergency procedures. These include obstetric and paediatric services such as caesarean section, anaesthesia and emergency paediatric services (Universitas Gadjah Mada 2020; Indonesia MOH 2020).

Investing in Puskesmas' BEmONC capacity

Another important maternal and child health initiative at the primary care level was aimed to improve access to emergency maternal and neonatal services by upgrading the capacity of Puskesmas to be able to provide Basic Emergency Obstetric and Newborn Care (BEmONC) (Ministry of Health 2008). The investment was also made to address the lack of confidence among the community in Puskesmas quality and readiness. Studies have shown that women and their family often perceived that Puskesmas are poorly equipped with shortages in both staff and basic equipment, and that the midwives are not properly trained or more unskilled and inexperienced compared to TBAs in some areas (Salam, Jati & Nugraheni 2017; Nurhidayanti, Margawati & Kartasurya 2018; Wijayanti 2015). In effect, women chose to deliver at home or risk the longer journey to district hospital instead of visiting a Puskesmas that was usually the closest facility in their area.

BEmONC Puskesmas must have inpatient facility and be able to provide 24-hour services for obstetric and neonatal emergencies. The services cover the periods of pregnancy, delivery, postpartum and neonatal. There are main essential functions that the BEmONC facility should cover, including treatment of pre-eclampsia/eclampsia, antepartum and postpartum haemorrhage as well as neonatal resuscitation. And thus, to meet the capacity as a BEmONC facility, Puskesmas' human resources, facilities and supporting equipment required a significant upgrade. Training for the BEmONC team that consists of doctor, midwife and nurses, has been rolled out across Indonesia since 2000. While not all Puskesmas in Indonesia were targeted to be upgraded to BEmONC facility, the government aimed that each district should have at least one BEmONC Puskesmas.

However, a decade following the rollout of the BEmONC initiative for Puskesmas level, the capability of Puskesmas was not optimal. Based on the 2011 Basic Health Survey, only 62% out of the total Puskesmas that were designed to have BEmONC capacity were able to deliver all of the signal functions of BEmONC facility. The signal functions define the capabilities that facilities must have in dealing with obstetric and neonatal emergencies at either the basic or comprehensive level (Table 3.3).

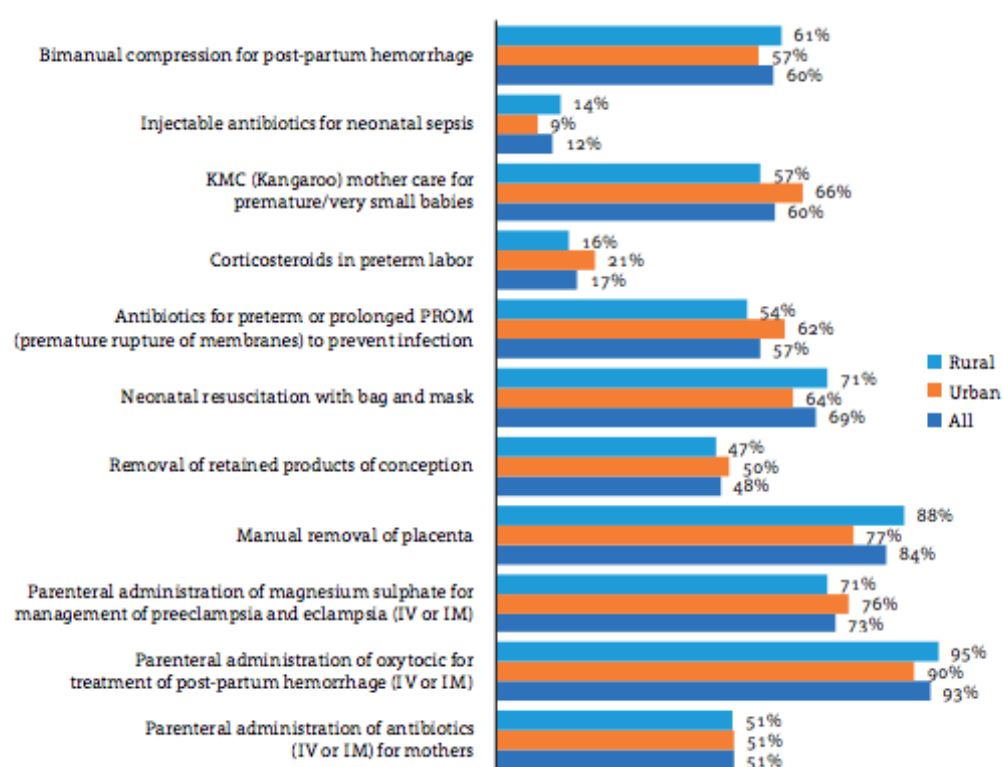
Table 3. 3 Signal functions for emergency obstetric and newborn care

Basic Emergency Obstetric and Newborn Care (BEmONC)	Comprehensive Emergency Obstetric and Newborn Care (CEmONC)
• Parenteral treatment of infections (antibiotics) • Parenteral treatment of pre-eclampsia/eclampsia • Parenteral treatment of postpartum haemorrhage (uterotonics) • Manual vacuum aspiration of retained products of conception • Vacuum-assisted delivery • Manual removal of the placenta • Newborn resuscitation	• All BEmONC components • Surgical capability • Blood transfusion

Source: World Health Organization, Monitoring emergency obstetric care: a handbook (2009)

A more recent nationally representative survey conducted by the World Bank in 2016 revealed that while over one-half of Puskesmas reported to be able to provide BEmONC services, the availability of BEmONC signal functions was low (Rajan et al. 2018). For instance, only 48% of the sampled Puskesmas offered the removal of retained products, meaning that if postpartum haemorrhage was caused by retained placental fragments, the intervention needed would not be available in more than half of the Puskesmas. Further, the survey also found variations in the availability of BEmONC signal functions between rural and urban Puskesmas (Figure 3.3).

Figure 3. 3 Availability of BEmONC signal functions at Puskesmas, 2016



Source: (Rajan et al. 2018)

Secondary health level

Hospitals in Indonesia mainly provide curative and rehabilitative services and are managed either by public or private entity. In 2019, there were a total of 2,344 hospitals, consisting of 228 (9.7%) hospitals managed by the ministries at the central level, 732 (31.2%) by province or district governments while 1,384 (59.0%) are private hospitals. Although the majority of hospitals are private entities, the size of private hospitals is generally smaller than public hospitals. And from a total of 310,710 hospital beds, only around 46.4% are in private hospitals.

The ratio of hospital beds per 1,000 population is 1.2 (Indonesia MOH 2020). While at the national level this ratio has met the WHO standard or at least 1 bed per 1,000 population, there are several provinces with very low hospital beds capacity, i.e. West Nusa Tenggara (0.7), East Nusa Tenggara (0.8), West Java (0.9), West Sulawesi (0.9), Central Kalimantan (0.9) and Riau (0.9). Hospitals are also less accessible than primary health centres where according to a national survey, only 67.3% of the population have access to a hospital (Sparrow & Vothknecht 2011). For maternal and child health, there are also challenges in physical accessibility to hospitals that provide CEmONC services. The World Bank reported that the median distance from a village to a maternity or general hospital is about 20 kilometer. However, densely-populated provinces in the Java-Bali region had much shorter distances to hospitals than in other provinces. For example, the median distance to maternity or general hospital in less-developed provinces including Central and West Kalimantan, Maluku and West Papua was three times higher than the national average (Kosen et al. 2014). This would add further delays in accessing services, particularly for the population in disadvantaged provinces.

There are issues in the readiness of facilities that provide CEmONC services. For instance, blood transfusion service is one of the key components of CEmONC services. However, a survey of public hospitals showed that less than two-thirds of hospitals have access to 24-hour blood transfusion service. Further, some provinces were also reported to have a very low proportion of hospitals that had access to blood transfusion services, such as in Papua, Maluku and Bengkulu provinces (Kosen et al. 2014).

In order to improve the quality of services, an independent hospital accreditation commission was established by the MoH to oversee the hospital accreditation program since 1996. The program aimed to improve service quality and patient safety, protect patients' rights, as well as to protect the hospital itself as an institution and its staff. Under this program, every hospital should be accredited every three years (Ministry of Health 2017). The target set by the Ministry of Health was for each district to have at least one accredited hospital. However, in 2019, only 85.7% of Indonesia's 2,344 hospitals had passed the accreditation process. Provinces with the highest proportion of accredited hospitals were Aceh, Bali, and South Kalimantan at 94.2%, 94.1% and 91.3%, respectively (Indonesia MOH 2020). Some of the challenges in the hospital accreditation program implementation include the lack of clarity on the roles and responsibility of the provincial

and district health offices, lack of integration across accreditation bodies that operate in Indonesia, limited engagement from hospitals' staff and clinical workers as well as political pressure on the government to provide hospital licences regardless of the accreditation status (Hort, Djasri & Utarini 2013).

3.3. 4 Maternal and child health programs in Indonesia: from community level, primary care to hospitals

The Indonesian National Health Development Program uses the primary health care concept where community health centres serve as the gatekeeper to health services and are supported by other community-based health care facilities as well as secondary level facilities or hospitals.

The lowest level of care for MCH is at the village level, where most facilities are community-based and mainly focused on preventive services and primary health care. These facilities include the integrated health post (*Posyandu*), village midwife clinic (*Polindes*), auxiliary Puskesmas (*Pustu*) and mobile Puskesmas. MCH services provided at this level include monitoring growth chart in children, health education and outreach immunisation services. In each sub-district, at least one community health centre is supposed to be headed by a doctor, supported by two to three subcentres that are mainly headed by nurses. However, as discussed in the previous sections, issues in the availability and distribution of human resources create variations in how Puskesmas are managed across districts and sub-districts in Indonesia. For MCH services, Puskesmas provide both curative and preventive services, including services that are provided by the subcentres plus consultation, simple laboratory tests. In addition, Puskesmas that are designated as BEmONC facility provide emergency services for maternal and neonatal health.

At the secondary level, hospitals are located either at the district, province, or central level. Out of a total of 2,344 hospitals in Indonesia, 2.4% are top-referral hospitals, 14.1 second-referral hospitals, and the rest (83.5%) are first-referral hospitals. District hospitals are the first-referral hospital that receive referrals from Puskesmas and private clinics. In the context of MCH, district public hospitals are supposed to be able to provide CEmONC services. However, not all district hospitals are equipped with the trained staff or infrastructure. Only some private hospitals, on the other hand, are designated as CEmONC facilities and usually located in larger districts.

At the province level, second-referral hospitals focus on more advanced clinical services and are usually equipped with more health specialists and infrastructure. At this level, both public and private hospitals are designated as CEmONC hospitals. Finally, top-referral hospitals are located in main cities and receive referrals from second-referral hospitals. Top-referral hospitals also provide CEmONC and services for complicated paediatric cases. Table 3.4 provides an overview of the different levels of service delivery for MCH in Indonesia.

Table 3. 4 Levels of health facilities and type of MCH services provided

Administrative level	Facilities	MCH Function
Village	Community-based facilities, including: • Integrated health post (<i>Pos pelayanan terpadu</i> or <i>Posyandu</i>) (volunteer-based) • Village midwife clinic (<i>Pos bersalin desa</i> or <i>Polindes</i>) • Auxiliary Puskesmas (<i>Puskesmas Pembantu</i> or <i>Pustu</i>) • Mobile service unit (<i>Puskesmas keliling</i> or <i>Pusling</i>) • Private clinics (physicians or midwives)	• Child growth monitoring • Health education and promotion • Immunisation • Family planning • Basic general health services
Sub-district	• Puskesmas (inpatient or outpatient)	• All services provided at the village level • Treatment of child malnutrition and mild-moderate infections • Maternal delivery and pregnancy services • Basic laboratory services For BEmONC designated Puskesmas (has to be inpatient Puskesmas): • All BEmONC signal functions • 24/7 inpatient facility including for child malnutrition, communicable diseases
	• Private clinics (physicians or midwives)	Private clinics: • Family planning • Child immunisation • Maternal delivery and pregnancy services • Basic general health services • Are not BEmONC designated facility
District	First-referral hospitals (CEmONC designated facilities)	• 24/7 CEmONC services • Specialist consultation • Laboratory facility
	Private hospitals (some are CEmONC designated facilities)	• Usually located in large districts • CEmONC services for hospitals that are designated and accredited as CEmONC facility • Family planning • Child immunisation

		• Maternal delivery and pregnancy services • Referral health services
	Private clinics (physicians or midwives)	Private clinics: • Family planning • Maternal delivery services • Basic general health services • Are not BEmONC designated facility
Province	Second-referral hospitals (CEmONC)	• 24/7 CEmONC services • Specialist consultation • Laboratory facility • More advanced clinical services compared to first-referral hospitals
Central		• 24/7 CEmONC services • Specialist consultation • Laboratory facility • More advanced clinical services compared to second-referral hospitals

Source: Ministry of Health (2014)

3.4 The national health insurance programme

3.4.1 Overview of Indonesia's current national health insurance programme

In 2014, Indonesia expanded its National Health Insurance program (*Jaminan Kesehatan Nasional/JKN*) by integrating all existing public insurance schemes. Previously, by the end of 2013, there were three major public social health insurance schemes in Indonesia; (1) government-funded insurance for poor and near-poor population or *Jamkesmas* (*Jaminan Kesehatan Masyarakat*); (2) social health insurance program for private and formal sector workers or called *Jamsostek* (*Jaminan Sosial Ketenagakerjaan*) and; (3) the insurance program for civil servants called *Askes* (*Asuransi Kesehatan*). All of the three insurance schemes had different benefit packages and different levels of premiums that depend on the income level and occupation statuses of the beneficiaries. For example, *Jamkesmas*, which had the largest share of beneficiaries, was funded by the government through subsidized premiums. Indonesia also had a MNCH-specific health insurance scheme, called the *Jampersal* (*Jaminan Persalinan* or Delivery Health Insurance) that was launched in 2014. The *Jampersal* was eventually integrated into JKN (see Chapter 4 for more details on *Jampersal* and MCH service use). In addition to the three national-level health insurance schemes and the *Jampersal*, district and provincial level governments have also funded their own insurance pooling, called the *Jamkesda* and *Jamkessos*, respectively. The two sub-national level insurance schemes aimed to cover the poor and near-poor population who are not covered under *Jamkesmas* (Harimurti et al. 2013). The benefit package among these insurance schemes also varied, with *Jamkesmas*, *Jamsostek* and *Askes* providing the widest range of health care services.

During its launch in January 2014, the JKN program was already the largest single-pool and single-payer social health insurance scheme in the world (Pinto, Masaki & Harimurti 2016; Agustina et al. 2018; Mboi 2015) covering 121.6 million participants; 96.4 million of which were government-subsidized members from the ex-*Jamkesmas* beneficiaries of the poor population, with significant expansion to the near-poor segment of the population. The rest of the beneficiaries were ex-members of the *Askes* and *Jamsostek* schemes. During its implementation, there has been a significant expansion for the poor and near-poor subsidized members as well as in the non-poor segment where by 2019, 218 million people have been enrolled in the JKN program. The government has stated its goal in the JKN roadmap strategic document to aim to cover all of the Indonesian population (projected to be around 260 million people) by the end of 2019 (National Board of Social Insurance et al. 2012). However, based on the latest available data, JKN covers around 222 million people as of August 2020, or only 85.5% of the total Indonesian population (BPJS Kesehatan 2020b).

In general, JKN has two main groups of enrollees; (1) the group receiving subsidized premium payment from the government or *Penerima Bantuan Iuran* (PBI)/Contribution Assistance Recipients, which includes poor population and individuals with disabilities and; (2) non-subsidized group or contributory group that consists of *Peserta Pekerja Penerima Upah* (PPU)/salaried employees (including government and private), *Peserta Pekerja Bukan Penerima Upah* (PBPU)/non-salaried workers and those categorized as *Bukan Pekerja*/non-workers. On the fund pooling aspect, funding for the JKN is generated through the premium collection. The poor and near-poor members who are covered under the PBI scheme are subsidized by the government budget that pays the premium directly to BPJS-Health, while salaried employees (formal sector) are required to pay premium contribution as a certain percentage of their salaries. On the other hand, non-salaried workers and non-workers pay a fixed amount of monthly premium based on their preferences of the class of inpatient ward (National Board of Social Insurance et al. 2012). The choice of inpatient ward class would mostly determine the amount of non-medical facilities received by the beneficiaries, but the quality of medical services received should be uniform across all types of JKN enrolment.

BPJS-Health (*Badan Jaminan Kesehatan Sosial-Kesehatan* or Social Health Insurance Agency) is the parastatal institution mandated by the legislation to manage the JKN, including for the fund pooling and purchasing of the services. BPJS-Health cooperates with both public and private health care providers to provide the benefit packages, from primary to secondary and tertiary levels of care. All public health facilities are mandated and automatically enrolled as partners of BPJS-Health. As of 2019, there were 9,955 *Puskesmas* (public primary health centres) enrolled as partners of BPJS-Health, while 5,286 private GP practices and 6,569 private primary clinics were enrolled as well as 1,185 dentists (BPJS Kesehatan 2020a). At the secondary and tertiary levels of care, 2,517 hospitals (or 89.5% of total hospitals in Indonesia) were also included as BPJS-Health partner providers. In addition, pharmacies and optical shops were also included as partners, amounting to 620 and 1,079, respectively.

The purchasing side of JKN applies capitation payment for the primary health care level and reimbursement system based on clinical case-based groupings at the secondary and tertiary levels. The capitation payment is aimed to allow for use of funds for both preventive-promotive care as well as curative care at the primary level. The funds can also be used by the health facilities to improve their capacity, including for investment in equipment and infrastructure, as well as to increase salary or payments for the staff. The case-based group reimbursement system set at the secondary and tertiary level of care pays for medical services rendered to the patients, based on the diagnostic group.

Several issues have been documented due to the payment systems and the differences in the readiness of facilities across the Indonesian region. For example, as the capitation payment is based on the number of beneficiaries assigned to a particular primary health centre or clinic, the larger the number of beneficiaries in the area, the larger the amount of capitation received by the clinic. This has led to health facilities in highly populated areas to be able to attract more health care professionals due to higher remuneration or proposed salaries. On the other hand, areas with small populations would be less attractive for health workers to work in (Meliala, Hort & Trisnantoro 2013). This has led to uneven distribution of health facilities and providers, which in turn may affect the access or availability of quality health care services.

In terms of the payment system applied at the secondary and tertiary levels of care, hospitals with better equipment and staffing would be able to provide a higher level of care that would garner higher reimbursement from the JKN system. As the reimbursement is set per patient and per diagnosis, health businesses have been more attracted to invest in hospitals where larger populations reside, compared to more remote areas with a less dense population (Health Policy Plus & TNP2K 2018). This is shown by the greater increase in the number of private hospitals after JKN implementation in large cities or metropolitan areas. On the other hand, remote areas are lagging behind both in the availability of high-level of care and in the growth of hospitals (MoH 2016).

A realist evaluation conducted by researchers at the Universitas Gadjah Mada in 2018-2020 aimed to tease out the different contexts in which JKN is being implemented to better understand whether the JKN program would be able to reach its target in creating equitable health care access universal for the whole Indonesian population (Trisnantoro et al. 2020). The study found that areas with limited resources are not able to absorb the available pooled funds because of the lack of available benefit packages compared to well-developed regions in Indonesia. For example, there are more than 20 centres in Yogyakarta province that could provide haemodialysis treatment, which is home to one of 21 general national referral hospitals and has sufficient numbers of doctors and medical facilities. On the other hand, the less developed and more remote province of East Nusa Tenggara, which has similar population size as Yogyakarta, has only 2 haemodialysis facilities. The stark difference in the availability of medical equipment and other health resources between the two provinces alone has resulted in very different levels of fund absorption. Yogyakarta's

JKN claims ratio amounted to 300%, meaning that the reimbursement of payments for hospitals and other health facilities was 3 times the fund pooled from the beneficiaries residing in the province. East Nusa Tenggara province, on the other hand, only absorbed 30% of its JKN pooled fund.

At the national level, most provinces with high population density and strong health systems delivery also experience high claims ratio. Based on these findings, the researchers of the study argued that from the national perspective, the JKN system has not been able to address the issue of uneven distribution in health resources. Moreover, since less-developed provinces such as East Nusa Tenggara and Papua cannot optimally absorb their JKN pooled fund, these provinces are indirectly subsidizing well-off provinces including Yogyakarta and Jakarta, the capital of Indonesia.

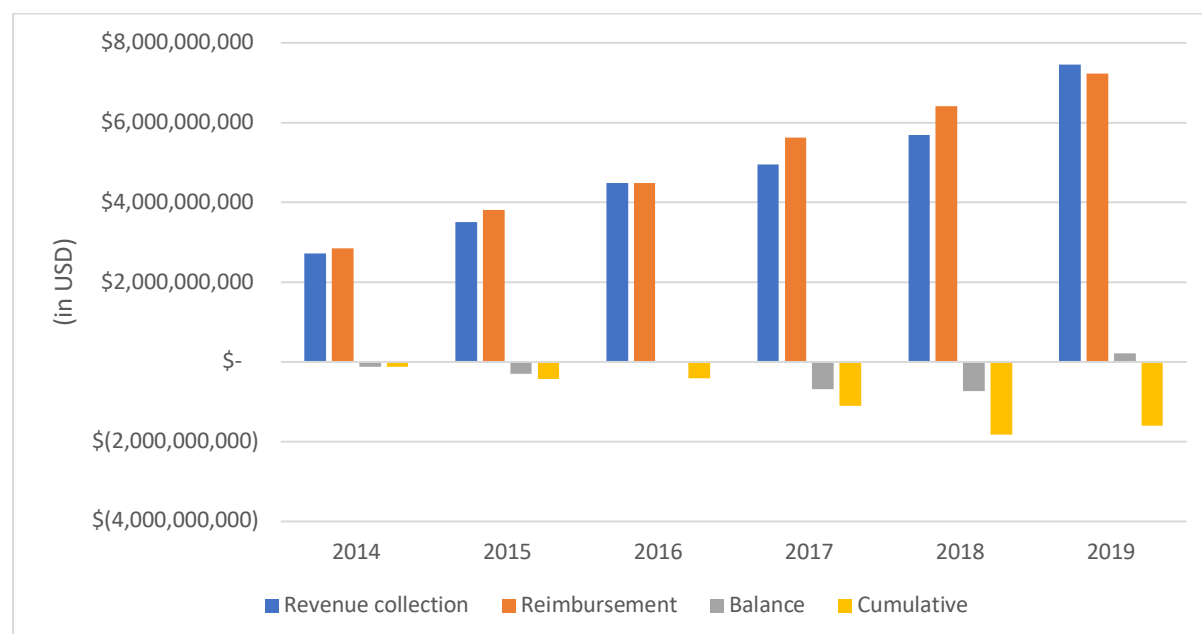
The realist evaluation also highlighted the regional disparity by using a case study on the availability of services pertaining to cardiovascular diseases. Cardiovascular disease is one of the leading causes of deaths in Indonesia (Mboi et al. 2018). One of the essential interventions available is the catheterization of the blood vessels, often used as life-saving measures for coronary artery diseases. As catheterization requires health facilities that are equipped with a catheter lab and trained cardiologist, the realist evaluation study mapped the availability of both of these essential resources across the different provinces in Indonesia. The researchers found that there is no available catheter lab outside the region of Java and Bali and very few trained cardiologists are available in the less-developed eastern part of Indonesia, including in East Nusa Tenggara and Papua provinces. Since the implementation of JKN, there has also been no significant change in the availability of these essential resources. Therefore, it was implied that the JKN system has not been able to address the geographical inequity issues since its rollout in 2014.

As the BPJS-Health expanded its cooperation with both private and public health care providers, the majority of private health facilities have been registered as implementing partners of the JKN. In this sense, BPJS-Health has managed to expand the availability of services by ensuring that the majority of health providers are providing care under the JKN scheme. However, geographical disparities in the availability of benefit packages exist and are predicted to widen the gap between well-developed and less-developed regions. A study by Trisnantoro et al. (2014) showed that the services, in particular high-cost services requiring high-end medical equipment and facilities, are mostly utilized by beneficiaries living in Java and Bali area, which have the most specialized care compared to the rest of the country.

The BPJS-Health has also been experiencing funding deficits since its inception in 2014. Low amount of premiums that are not based on actuarial estimates, low revenue collection from the informal sectors and other design and implementation flaws (e.g. uncapped hospital reimbursement scheme and limited incentives for providers to manage resources more efficiently) were the main contributing factors to the deficit (World Bank Group 2020a).

Based on the latest available data, the cumulative deficit of BPJS-Health has amounted to USD 1.6 billion at the end of 2019.

Figure 3. 4 JKN financial performance, 2014-2018 (September)



Source: BPJS-Health Financial Report (2020c)

Chapter 4: Literature review

Chapter Four synthesizes published literature on the determinants of maternal and child health care seeking, and the definitions and means of assessing socioeconomic and geographical health inequalities. The review compares several theoretical frameworks that have been used to understand the determinants with a special emphasis on frameworks that incorporate health systems perspective. Chapter Four also pays special attention to literature assessing the effect of health insurance or user-fees removal on maternal and child health service utilisation and health outcomes.

4.1 Definition and the measurement of socioeconomic health inequalities

Inequality in health has been defined as the variations in health status across individuals in a population (Gakidou et al. 2006). While at times used interchangeably with health inequality in research (Leeder 2003; Williams & Doessel 2006), health inequity has a distinct definition. The WHO defined health inequity as differences in health that are unnecessary and avoidable (1986). Whitehead (1991) later on added the WHO definition of health inequity with moral and ethical dimensions and proposed that health inequity is not only differences in health that are unnecessary and avoidable but also, considered to be unfair and unjust.

Documenting the level of differences across different regions and time periods is important to monitor whether the health system has managed to provide health care for all in an equitable manner (Boerma et al. 2018). A number of summary indices have been used to measure socioeconomic inequalities in health (Gakidou et al. 2006) but there is little consensus about which measurement is the most appropriate to monitor changes over time (Barros & Victora 2013; Barros et al. 2010; Bertoldi et al. 2019; Heslehurst et al. 2010; Boerma et al. 2018; Houweling, Kunst, et al. 2007). As health inequalities often involved socioeconomic variables that have more than two levels (e.g. wealth inequalities, education level, types of occupation, parity, etc), researchers have advocated for the use of measurements that assess the inequality level across the entire distribution of socioeconomic positions (Barros & Victora 2013; Victora et al. 2000; Hodge et al. 2014). These include the concentration index, slope index of inequality (SII) and relative index of inequality (RII). By taking into account the entire distribution of the socioeconomic position, such measurement extended the understanding of inequality beyond only comparing between two extreme groups. For example, if one is to compare the health status between the poorest and richest quintile, this would ignore 60% of the population. On the other hand, the concentration index for example, provides the quantification of how the health variable is distributed across all wealth quintiles.

While wealth and other variables such as education level and types of occupation have been widely used as the comparator variable in assessing inequality in health (Adegbosin et al. 2019; Collin, Anwar & Ronsmans 2007; Falkingham 2003), the geographical location of women and children is also found to be an important determinant in the inequality in health care services and outcomes (Asamoah, Agardh & Cromley 2014; Pulok et al. 2018; Jimenez-

Soto, Durham & Hodge 2014; Ruktanonchai et al. 2016; Amporfu & Grépin 2019; Viegas Andrade et al. 2012). This is particularly the case for island countries, and LMICs more generally, where socioeconomic status is generally lower with large urban-rural and geographic differences in the availability, accessibility and affordability of quality health services. People living in underserved areas are consistently shown to have significantly lower access and utilisation of life-saving MCH services (Say & Raine 2007; World Health Organization 2015b).

Geography and health are inextricably linked. Where we are born and live directly affects our health through a myriad of channels, such as the air we breathe, the food we grow and eat, the type of work we are likely to do, the health services that we can afford and access (Dummer 2008). Wealth, education and other demographic characteristics are important determinants, however, these factors are often outside the scope of health systems interventions or programs. Further, most health policies are implemented at the local or regional level. For instance, in large countries such as Indonesia or Brazil, regions are politically and geographically divided, with variations in physical, demographic and socioeconomic characteristics (Mahendradhata et al. 2017; Szwarcwald et al. 2016). Local governments often have the autonomy to plan and budget for health resources, including how doctors, midwives and hospitals are distributed and funded. These health systems factors, that correlate with the location or geography where individuals live, would be instrumental in determining the physical access to health services. Therefore, assessing inequalities between regions within a country would be important to promote actions and programs to improve health equality.

There has been a growing interest in assessing geographical inequalities in MCH service use and outcomes in LMICs with geographical factors often denoted using a dummy or categorical variable denoting urban or provincial residence (Jimenez-Soto, Durham & Hodge 2014; Say & Raine 2007; Titaley, Dibley & Roberts 2010). These studies found that the urban population often has the advantage in accessing MCH services compared to their rural counterparts. Further, regions that are less-developed within a country also have significantly lower coverage of key maternal and child health interventions and outcomes. However, there are still few papers that examine the factors that contribute to the geographical inequalities themselves, and among those that do, the focus is on demand-side factors with supply-side factors seldom included (Jimenez-Soto, Durham & Hodge 2014; Ruktanonchai et al. 2016). Supply-side factors, that vary widely across regions within a country (A. Gupta et al. 2018; Rajan et al. 2018; Gopalan et al. 2014; Cavallaro et al. 2020), have been found to be important determinants of health care utilization and health outcomes in many settings (Filippi et al. 2006; Goodman et al. 2002; Hotchkiss 2001). Therefore, there is a need to build on existing literature and provide a more comprehensive understanding of how geographical inequalities in MCH service utilisation are explained by both health systems demand and supply-sides.

4. 2 Socioeconomic and geographic inequalities in maternal and child health service utilisation

Frameworks for health care service utilisation

There are several frameworks pertaining to health service delivery, and in particular maternal and child health care services. One of the frameworks that directly relate to maternal health service use was proposed by Thaddeus and Maine (1994). This framework outlines the three points or phases of delay that affect the level of access and use of quality maternal health services in a timely manner. As the framework is useful in assessing the delays in using emergency obstetric care, to some extent it is also applicable for assessing the determinants of early neonatal deaths. The three phases of delay are; (1) delay in deciding to seek care; (2) delay in reaching a health facility and; (3) delay in getting adequate treatment after reaching the health facility.

The first delay, described as *“delay in deciding to seek care on the part of the individual, the family, or both”*, can be affected by the status of women within their households, factors that may affect the decision making process of whether to come to a health facility or not (e.g. distance from health facilities, availability and cost of transportation, perceived cost of treatment at the facility, previous exposure or experience with the health service) and the perceived quality of care that women are expecting to get from the service delivery point. In terms of geographical barriers, Thaddeus and Maine have noted that distance from the potential patient to the nearest health care facility is an important barrier to health care seeking. Moreover, for the population living in the rural area, distance to a health care facility has an even larger effect on health care seeking and acts as a disincentive to actually access and utilize maternal health services in a timely manner. Such findings are also still relevant in more recent literature from LMICs (Afsana & Rashid 2001; Agobuo et al. 2011; Hotchkiss 2001; Amporfu & Grépin 2019).

The second phase, described as delay in *“reaching an adequate health care facility”*, is influenced by the referral systems available including geographical factors such as road condition to the facility, distance and the availability of health resources in the proximity of where the pregnant woman lives. Thaddeus and Maine also noted that reaching the first point of contact with a health facility might not mean the end of a woman’s journey in accessing health services. For example, if the primary health centre or periphery health post that was being accessed was not equipped for delivery or emergency services, referral to a higher level of care is warranted. This could lead to further delays in reaching an adequate health facility.

In this context, health facility readiness plays an important role. Previous studies from LMICs have shown that even facilities that are supposed to provide CEmONC services are in reality, often not fully equipped to manage such cases (Conlon et al. 2019; Agborsangaya et al. 2012; Pedrana et al. 2019; Roy, Biswas & Chowdhury 2017; Tembo et al. 2017; Cavallaro et al. 2020; Ashish et al. 2020). Further, the studies also documented that trained human

resources are lacking, even in facilities that have adequate equipment and infrastructure for CEmONC services. The limited availability of different types of high-cost equipment could also hinder the CEmONC service delivery. For example, the unavailability of a blood bank that is essential in the management of antepartum or postpartum haemorrhage is often cited to be one of the most debilitating shortages in health facilities. Such challenge has led to mismanagement of obstetric patients and eventually, maternal death (Sobhy 2017; Prin et al. 2019; Maswime & Buchmann 2017; Ologunde et al. 2014).

Accessibility to quality obstetric and neonatal cases also varies between urban and rural areas. For example, while electricity supply and backup generators are common for urban health facilities, limited basic amenities such as electricity and a clean water supply have posed significant barriers in providing quality maternal care in rural areas (Sochas 2020; Nyamtema et al. 2016; Compaoré et al. 2014). Based on the health facility survey conducted in Indonesia, approximately 17% of Puskesmas lack access to electricity and around 30% did not have clean water supply (NIHRD 2013). Further, more than 50% of health facilities in the less developed region of the eastern part of Indonesia did not have a 24/7 supply of electricity and would have limited access to clean water distribution (Rajan et al. 2018).

The third or final phase of delay described as the delay in *“receiving adequate care at the facility”* is affected by limited resources at the facility setting, including medical supplies, availability of medical personnel and clinical competence of the health staff. Low-level readiness at hospitals has led to near misses and maternal deaths with issues including insufficient medical equipment and trained staff cited as the major contributing factors (Assarag et al. 2015; Pacheco et al. 2014; David et al. 2014; Morof et al. 2019). As stated in Chapter 2, while the numbers of maternal and neonatal deaths have declined over the decade, there is a shift in maternal deaths from home setting to facility-level. Such shift occurred due to higher use of facility-delivery but also unaddressed issues in the readiness of facilities in handling emergency obstetric cases.

Another framework that has been adopted by studies looking at inequalities in maternal and child health care settings is Aday and Andersen’s (1974) behavioural model on health care utilisation. In his subsequent manuscript, Andersen (1995) provided updates to the framework and grouped different factors that may influence the access to and utilisation of quality health care services as follows: (1) predisposing factors; (2) enabling factors; (3) need factors and; (4) external environmental factors. The predisposing factors are the sociodemographic characteristics either at the individual or the household level. In the context of maternal and child health care, these include age of the mother, cultural and racial background as well as parental education level and the employment status. The enabling factors facilitate the individuals or the women to use the needed health services, which include the income level of the women or the family, access to free services, availability and access to the service providers. Need factors are defined as the physical conditions or illnesses that would alter the likelihood of health service utilisation. And external environmental factors exist outside of the health system and the individuals who

seek health services but influence the choices and the feasibility of women and children to reach and use health services. These may include the types of residence, e.g. rural or urban or a particular region within a country.

Andersen's model, while primarily about health-seeking behaviour, has started to incorporate the components of the health system. This was done by including accessibility or availability of health resources within the enabling factors. The model also allows for a better understanding of risk and protective factors associated with health-seeking behaviour. However, there are several limitations of this model. First, the model tends to use a unidirectional process starting with the environment and population characteristics, health behaviour and outcomes. There is limited emphasis on the possible dynamics and interactions between the different determinants and how the interaction can vary across different contexts. Second, while the model highlighted the role of individual and household factors, it did not consider these as being part of the health system. And finally, while the model provides a useful way of identifying important determinants, it is not designed to help evaluate health programs using a health systems perspective and the impact of the programs on MNCH outcomes.

In a widely cited systematic review, Say and Raine (2007) proposed a set of categorizations of different determinants that influence inequalities in maternal health service utilisation in LMICs. The categories were factors related to the users (e.g. age, health insurance coverage, education level, clinical risk factors); health care supply-side factors (e.g. availability of clinics, distance to facility) as well as interactions between the factors (e.g. perceived quality of care). Say and Raine's systematic literature review extended the understanding of the different barriers and enablers of maternal health care service utilisation, focusing on LMICs and using tight inclusion and exclusion criteria in their selections of publications. Their study also acknowledged the different degrees in which the determinants may affect the actual use of maternal health care services, noting that while there are differences across regions in the world, similarities of the determinants are noteworthy as well. Further contextual issues related to health care organisation or social and cultural issues were also noted in their review, emphasising the need for further studies that look at context-specific causes in the inequalities of maternal health care utilisation.

Health system frameworks for maternal and child health care service utilisation

While Say and Raine's review as well as the Andersen model have considered the interactions between some of the health system components (i.e. the health supply-side) and local contextual factors, most of the determinants are within the scope of socioeconomic aspects and demand-side factors. More recently, there has been a growing interest in using a health systems perspective in an effort to improve maternal, neonatal and child health outcomes (Ergo et al. 2011; Sochas 2020; Parkhurst & Ssengooba 2009; Kruk et al. 2016).

Health systems have been defined in many different ways. The WHO (2000) defines health system as “*all the activities whose primary purpose is to promote, restore or maintain health*”, and this is the definition that is now widely used. Roemer (1993) defined health systems as the combination of various resources including financing, and the organisation and management of these resources that culminate in the provision of health services for the population. The relationship of the different actors in the health care system was also coined by Evans (1981) with the emphasis on the market and non-market interactions. Further, Hurst (1991) focused on the financial flows and payment approaches between the the population and institutions, a definition echoed by Cassels (1995) that defined health systems from the perspective of economic relationships between demand, supply and intermediary agencies that influence the demand-supply relationship. More recently, Hsiao (2003) proposed that health systems can be conceptualised as “...a set of relationships in which the structural components (means) and their interactions are associated and connected to the goals the system desires to achieve (ends).” And in his paper, Hsiao limits the health systems boundaries to the factors or components that can be used as policy instruments to attain certain goals.

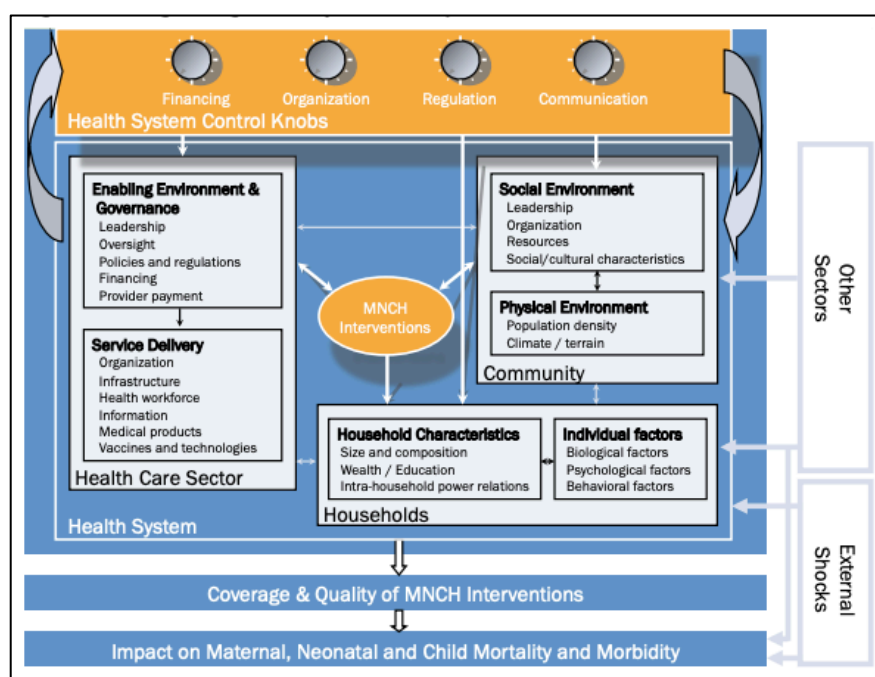
When considering a health system, systems thinking is important to adopt as it provides the perspective to view the system as a whole rather than the individual components within it. A system is not just a set of individual components. For example, health system components would include human resources, health facilities, health financing and others, but the essence of the system itself is different from the sum of its parts (Frenk 1994). The emphasis of a system is the interconnection and interdependence between the different parts. In effect, changes in a single component such as through a policy that affects a certain part of the system, could create repercussions for the entire system. The impact of the changes on an element would also depend on the other elements of the system and the dynamics between them.

Ergo, Eichler, Koblinsky and Shah (2011) developed a health systems framework around improving maternal, neonatal and child health (MNCH). More specifically, the framework highlights the importance of health systems strengthening for improving MNCH outcomes. The framework was a reaction to the growing global agreement that improving maternal and child health outcomes requires well-functioning health systems (Mc Donagh & Goodburn 2001; World Health Organization 2007, 2005). Further, most MNCH interventions, including family planning, are largely determined by the overall health systems performance in which the interventions are being implemented (Walt 2004; World Health Organization 2005; Walt 2004). The framework builds on previous health system frameworks, including the ‘control knobs’ that was proposed by Hsiao and Roberts (Hsiao 2003; Roberts et al. 2003), Claeson’s conceptual framework that that connects government policies to population health outcomes (Claeson et al. 2001) and the WHO building blocks (World Health Organization 2007).

In their paper, Ergo et al. stated that while the existing frameworks offer valuable insights into the understanding of health systems and health systems strengthening, there are also some limitations. For example, Claeson et al. showed how policy changes can influence how the health systems perform and eventually can affect health outcomes. However, this framework did not consider the role of communities and households in health programs as being part of the system. This is particularly applicable in LMICs, where MCH programs such as family planning, oral rehydration therapy, community-based integrated management of childhood illness (CB-IMCI) as well as some promotive and preventive programs, are being implemented not just at the community level but also largely driven by the community (Dawson et al. 2008; Mosites et al. 2012; Ahmed et al. 2011; Hull 2010; Shiffman 2007). The WHO framework that defines the health system in six 'building blocks' could also lead to promoting isolated initiatives that only address particular components of the health system. At the country level and with a diverse range of health care delivery systems and contexts, it would be more useful to have a framework that recognises the interrelation and interdependence between all components of the health system.

The framework by Ergo et al. is presented in figure 4.1 below, in which MNCH interventions are implemented within the interactions of the main components of the health systems: (1) the health care sector (enabling environment and governance and service delivery); (2) the community (physical and social environment) and; (3) the households (consists of individual and household characteristics). The framework emphasises the interconnectedness of the various elements of health systems. This implies that while some HSS efforts may focus on only a certain components of the health systems, it is still ultimately the system as a whole that determines the coverage and quality of MNCH interventions and virtually, maternal and child health outcomes.

Figure 4. 1 Framework of strengthening health systems to improve MNCH outcomes



Source: Strengthening health systems to improve maternal, neonatal and child health outcomes: a framework (Ergo, A, Eichler, R, Koblinsky, M & Shah, N 2011, 'Strengthening health systems to improve maternal, neonatal and child health outcomes: a framework', Washington, DC: MCHIP, USAID).

The four control knobs (financing, organisation, regulation and communication) at the top of the framework allows for detailing various health systems strengthening (HSS) initiatives and assessing how these initiatives may result in changes within the health system, whether these changes brought any effect on the coverage and quality of MNCH interventions and their impact on the health outcomes. Finally, the framework allows for a dynamic perspective in analysing the linkages between HSS initiatives and MNCH outcomes. For instance, the central part of the framework allows to map out what is happening within the health system and identify the main challenges. The combination of HSS initiatives that were adopted to address the challenges can be depicted by the control knobs at the top of the framework. The health system, in turn, reacts to the HSS initiatives and comparing the situation of the health system before and after the implementation of the HSS initiatives would reveal how changes have been made and what new challenges arise.

Effective coverage for MCH interventions: a framework for health systems performance assessment

Health system performance is assessed on how it delivers health interventions to achieve the desired outcomes on population health. In the case of MCH, the health interventions are available across the continuum of care; from pre-pregnancy to delivery, the immediate postnatal stage and throughout childhood period (Kerber et al. 2007). As presented in Chapter 2, essential MCH interventions across the continuum of care are well defined. The coverage levels of these interventions are monitored across countries, which is essential for tracking the progress towards achieving SDG Goal 3. However, while the coverage levels of many MCH interventions have increased in the past decade (Boerma et al. 2018), there is a concern that national coverage indicators may overplay the positive benefits of the interventions on health because of poor quality of the services (Hodgins & D'Agostino 2014; Shengelia et al. 2005; Kanyangarara, Munos & Walker 2017; Leslie et al. 2017).

In the case of ANC for example, the coverage of ANC service has steadily increased over the past decades and the majority of women (90%) have at least received one ANC visit. However, according to a multi-country study, only 57% received the recommended four or more ANC visits (ANC4+) (Countdown to Collaboration 2018). Further, there is an even lower percentage of women who receive key components of ANC. For instance, a study that assessed the quality of ANC services in 41 LMICs found that among women who received at least 4 ANC services, only 79% received tetanus toxoid immunisation and only one-third received iron-folic acid supplementation during pregnancy (Hodgins & D'Agostino 2014). Such gap between the coverage of ANC4+ and the receipt of the components of ANC reflects that the quality of ANC services was low and could lead to unwanted health outcomes. In this case, the failure to immunise pregnant women with tetanus toxoid could lead to an increased risk of maternal and neonatal tetanus infection. And the lack of iron-folic acid supplementation could increase the risk of maternal anaemia and subsequently higher risk of maternal postpartum haemorrhage and sepsis as well as low birth weight and preterm birth (World Health Organization 2019c, 2015a).

There is also a tendency to track only the ‘crude’ coverage of the interventions, instead of how the interventions could actually translate to the desired health outcomes. This is particularly the case for global initiatives that call for certain process variables related to intervention coverage to be achieved. For example, as part of a process indicator to reduce maternal mortality, one of the sub-targets of MDG 5 was to increase the number of births attended by skilled personnel. And thus, subsequent studies that report the tracking of the progress to achieve the goal were mainly focused on skilled birth attendance (SBA) coverage (Say & Raine 2007; Collin, Anwar & Ronsmans 2007; Falkingham 2003; Asamoah, Agardh & Cromley 2014). While the use of SBA coverage as ‘crude’ coverage of maternal delivery service is helpful as a comparable variable across countries and time periods, it does not account for the quality of services and the impact of the increase in coverage level on maternal and newborn health (effective coverage).

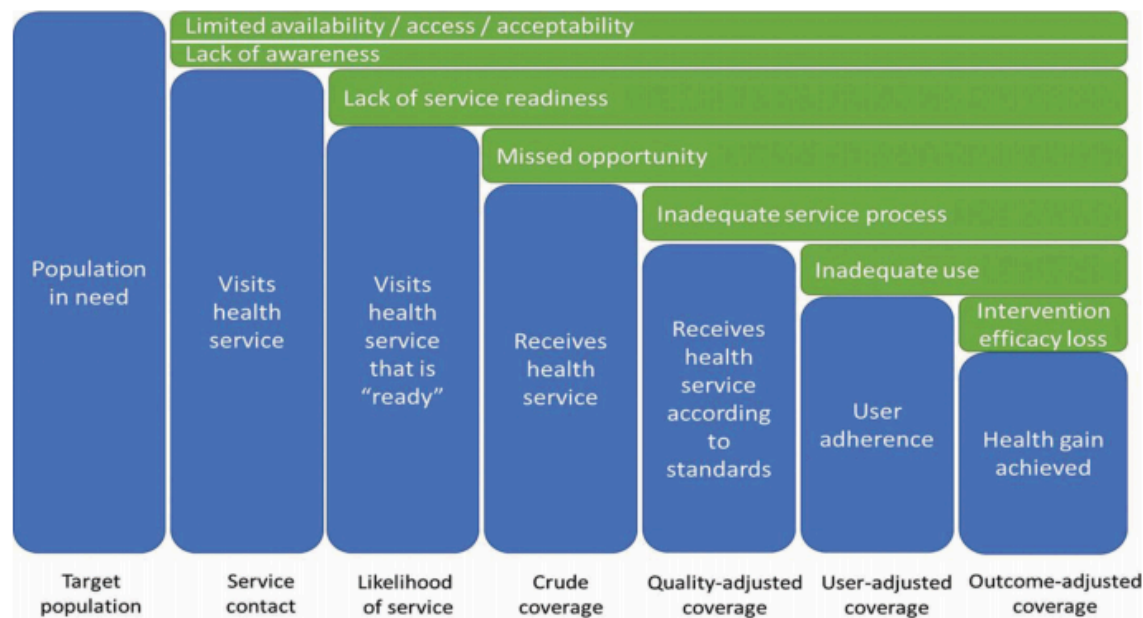
And thus, there have been increasing interests in measuring what is called now ‘effective coverage’ indicators. Developed by Evans et al., the effective coverage framework is based on the idea that a comprehensive assessment of the health system should incorporate the measurement of the completeness of services received and the quality of the service, as an intermediate step to measure the impact of a health intervention (Evans 2003). Shengelia et al. (2005) proposed the definition and framework of effective coverage that could explain the gaps in health service delivery. The effective coverage framework has been used to assess health service coverage for several health conditions and interventions, including non-communicable diseases, malaria, childhood illnesses, surgery, as well as assessing the performance of countries’ health systems (Shengelia et al. 2005; Rupani, Gaonkar & Bhatt 2016; Galactionova et al. 2015; Ng et al. 2014; López-López, Gutiérrez-Soria & Idrovo 2012; Ozgediz et al. 2009; Lozano et al. 2006).

Apart from its simplicity in terms of assessing health-system performance across the MCH continuum of care, a key advantage of the effective coverage approach is that it offers a standardised approach to identify the losses of potential health benefits or gaps that can occur at each step of the coverage cascade. This allows for determining which health systems challenges require immediate attention or which sub-population requires more resources. There is a growing interest to apply the effective coverage framework in RMCH including the recommendation from the WHO and UNICEF to use the effective coverage approach for RMCH as part of health system performance evaluation and monitoring of universal health coverage (UHC) (Evans 2003). More recently, Amouzou et al. and Marsh et al. presented an effective coverage framework within the MCH context, which proposed a seven-step coverage framework as seen in figure 4.2. The framework for MCH intervention cascade could sit well with Ergo et al.’s health system framework for MCH improvement in Figure 4.1 (Ergo et al. 2011) as effective coverage can be used to as a tool to evaluate the ‘coverage and quality of MCH interventions’ at the bottom of the framework.

The framework provides an overview of how a certain health intervention is delivered using a cascade of care. In each step of the cascade of care, a patient may lose the potential

health benefit of the intervention due to different reasons including access to the health service, readiness issues at the health facility (e.g. staff competence, infrastructure and medical supply availability) and the compliance of the patients themselves to adhere to medical advice.

Figure 4. 2 Cascade of health interventions and the potential loss of health benefits along the care cascade



Source: Amouzou et al. (2019)

As seen in Figure 4.2, the framework starts from a target population to (1) service contact, or the proportion of the target population who visited a health service; (2) likelihood of service, or the proportion who visited a health provider or facility that has the capacity to deliver the needed service; (3) crude coverage, or the proportion of the target population who utilised the health intervention; (4) quality-adjusted coverage, or the proportion of the target population that received the health service according to recommended clinical standards; (5) user-adherence-adjusted coverage or the proportion of the target population that received services according to recommended clinical standards and adhered to treatment guidelines and finally; (6) outcome-adjusted coverage, or the proportion of the target population that experienced expected health gains from the health service and finally; (7) the health gain achieved from the intervention that is being delivered (Marsh et al. 2020; Amouzou et al. 2019).

In terms of health system performance assessment, the effective coverage framework offers new insights as the cascade could help identify where the gaps exist and what possible health systems components should be addressed to alleviate the issue. For example, if a large gap was identified between crude coverage and quality-adjusted coverage, one possible explanation would be that health staff and facilities were not fully equipped to deliver quality health services. Further exploration may reveal that the issues

could be the level of training that the staff received or the supplies or medical equipment at the facilities were not fully available to support the necessary service delivery. On the other hand, if the gap was between the quality-adjusted and user-adherence coverage, the problem might be due to patient compliance. This could relate to health knowledge of the patient or awareness, cultural issues or trust in the health care providers.

While the framework offers a new insight into monitoring health service delivery and health systems performance, there are some caveats in using the framework for monitoring MCH intervention coverage. The issues relate mainly to the availability of the indicators needed to construct the care cascade. Most health indicators in LMICs are collected either through national programs reports or population-based surveys such as the Demographic Health Survey (DHS). However, many of the indicators needed to measure the effective coverage are not available in these reports. For example, one of the quality indicators for postnatal care for the newborn baby is that all postnatal care standards are met. These include the general evaluation of any health issues (e.g. feeding problems, convulsions, fast breathing, severe chest in-drawing, loss of spontaneous movement, fever or hypothermia and jaundice), exclusive breastfeeding, cord care using chlorhexidine as well as other postnatal care services (World Health Organization 2013). However, most of these interventions are not fully reported either in national programs report or the population-based survey. DHS for example, only assessed cord care, temperature check and counselling on danger signs in newborn and breastfeeding (DHS Program 2018).

Another issue relates to the lack of consensus on the measurement and the operational definition used to assess the different indicators within the effective coverage framework. In particular is the quality indicator, which is a multidimensional approach that does not only take into account the input-process-output measurement, but also the patient perspective based on their experience from receiving the care (Donabedian 2005, 1988). And therefore, there have been variations in the quality measurement across published studies that used the effective coverage framework (Leslie et al. 2017; Hodgins & D'Agostino 2014; Ng et al. 2014; Lozano et al. 2006; Galactionova et al. 2015; Nguhiu, Barasa & Chuma 2017).

4.3 Factors associated with maternal and child health care utilisation

Based on the frameworks reviewed in the previous section, the determinants of health-seeking for maternal and child health services can be divided into three levels; (1) the health care sector level, that includes the enabling environment and service delivery; (2) the community-level factors including the social and physical environment, and; (3) individual and household levels. This section reviews existing evidence on the determinants of health-seeking for MCH services by focusing on literature applying quantitative methods.

Determinants at the health care sector level

The availability of health resources is an important factor in improving the use of MCH services within an area. However, there are few studies that include health system supply-

side as determinants of the inequality. Fang et al. (2010) found that inequality in MNH between regions in China was related to the distribution of health resources including infrastructure and human resources. Another recent study from Ethiopia by McKinnon et al. (2014) shows that distance to well-equipped health facilities correlates to neonatal mortality, highlighting that access to obstetric care such as CEmONC would increase the likelihood of utilisation and better health outcomes for both the mother and newborn. However, there are still limited studies, globally and on Indonesia, which assess geographical inequalities that are also focused on health systems determinants such as the availability of health resources and the quality of services. Similar studies from Indonesia that assessed the level of regional inequalities in maternal health care utilisation and child mortality also did not take into account health systems factors in their model (Hodge et al. 2014; Tripathi & Singh 2017).

Insurance coverage also serves as an enabling factor, where it may reduce the out-of-pocket expenditures from health service utilisation. However, insurance coverage and its effect on improving health care utilisation and outcomes highly depends on a larger context, including physical access to quality health services particularly among the poor population, behavioural factors that may influence the use of health services and the overall quality of the provision of health services (Balarajan, Selvaraj & Subramanian 2011; Sarpong et al. 2010; Yip, Wang & Liu 1998). The next section discusses in more detail how insurance or user-fees reduction policies have impacted the use of MCH services.

Determinants at the community level

At the community level, there are several key determinants for MCH service utilisation. First, in LMICs, cultural factors affect the use of maternal and child health services, which may include religion or ethnicity (De Allegri et al. 2011; Kitui, Lewis & Davey 2013). Previous studies have shown that particular religions or ethnicities at the country-level were negatively associated with using maternal health care services. For example, Burkina Faso women holding animist religion were less likely to use MNH services compared to their Christian or Muslim counterparts (De Allegri et al. 2011). However, cultural factors are highly dependent on their contexts or country of analysis as other studies also showed that there is no correlation between religion or ethnicities and the use of obstetric services (Navaneetham & Dharmalingam 2002; Tarekegn, Lieberman & Giedraitis 2014). Studies from Indonesia also found no significant correlation between ethnicities or religions and the use of maternal health care services (Titaley, Dibley, Roberts, 2009; Titaley, Dibley, Roberts, 2010).

It is also interesting to note that while some services integral to the maternal health continuum of care may have a high rate of utilisation, some others would have significantly lower use. And the gap may be explained by the differences in how women and the community perceived ANC and SBA. For example, ANC service coverage has been consistently high, both in HICs and LMICs (Kanyangarara, Munos & Walker 2017; Collin, Anwar & Ronsmans 2007; Hodgins & D'Agostino 2014). While there are concerns over the

quality of ANC services in some areas, it is universally well accepted and utilized by women. However, ANC does not seem to always positively correspond with the subsequent service within the maternal health continuum of care, i.e. skilled birth attendance (Say, Pattinson & Gülmezoglu 2004; Amouzou et al. 2019; Boerma et al. 2018). Some studies indicate that women, particularly in rural areas, perceive that SBA or institutional delivery is not culturally acceptable or appropriate (Maimbolwa et al. 2003; Lin, Xirasagar & Tung 2006; Ababor et al. 2019).

A qualitative study by Titaley (2010) assessed the reasons why women in a rural district in Indonesia prefer to use traditional birth attendants (TBA) over skilled ones. She found that these women perceived that SBA is only aimed at women with complicated deliveries and also that TBAs are more culturally acceptable for their birthing experience. These factors have led to lower utilisation of skilled birth attendance and facility-based delivery.

Determinants at the individual and household levels

Determinants at the individual and household levels relate to income or financial situation of the women, levels of education, age of women and parity, as well as the possession of health insurance and employment status. These factors are highly related to Thaddeus and Maine's three phases of delay framework. For example, the first delay relates to deciding to seek appropriate medical care during an obstetric emergency. Access to financial support would affect this delay because patients who anticipate high costs for transportation and care may decide to not seek care at all.

In the context of LMICs, the ability to pay has been linked with better use of MNH services, where women from the richer income quintile are more likely to use health services, compared to the poorer population (Gage 2007; Koblinsky et al. 2006; Navaneetham & Dharmalingam 2002; Say & Raine 2007; Stekelenburg et al. 2004; Zere et al. 2007; Zere et al. 2010). According to a previous review from LMICs and studies in Morocco and India, another factor that determines health care use is the women's occupation status, where employed women have a higher likelihood to use MNH services (Say, Pattinson & Gülmezoglu 2004; Assarag et al. 2015; Navaneetham & Dharmalingam 2002). This is because women's occupation status relates to better income as means to overcoming economic barriers. In addition, women who hold paid job may also have better empowerment and bargaining power within their household to advocate for the use of household resources to access health care during their pregnancies or deliveries. In the Indonesian context, similar associations are found between household income level, women's occupation status and the use of key maternal and child health services. For instance, a recent study found that Indonesian women from the richest wealth quintile were more likely to utilise ANC services, skilled birth attendances as well as facility-based delivery compared to their poorest counterparts (Nababan et al. 2018). Further, women occupation status also remain important determinants of maternal and child health care utilisation in Indonesia (Nababan et al. 2018; Nasution, Mahendradhata & Trisnantoro 2019; Titaley, Dibley, Roberts, 2010)

Intra-household power relations are also an important determinant in MCH care utilisation, in particular the empowerment of women within the household. Previous studies in a range of both Asian and African contexts have found a positive association between mother's decision-making power and the use of key maternal interventions including antenatal care, facility-based delivery and postnatal care services (Tsegay et al. 2013; Richards et al. 2013; Vidler et al. 2016; Haider, Qureshi & Khan 2017; Adhikari 2016). Further, previous studies conducted in other LMICs also indicate that joint decision-making between the husband and wife increases the likelihood of using maternal health services (Chattopadhyay 2012; Ganle & Dery 2015; Yargawa & Leonardi-Bee 2015; Byamugisha et al. 2010). Despite this, limited women's involvement in health-seeking behaviour is still observed in some countries around the globe. For example, in Nepal, 75% of households reported that health-seeking decisions on women's behalf was decided without their participation (Senarath & Gunawardena 2009). Meanwhile, in Ethiopia, out of 65% of women who have access to finances, only 38% have full autonomy to use the money for health services without discussing with other family members (Nigatu et al. 2014). Similarly in Indonesia, women with more autonomy within the households were more likely to use ANC service, institutional delivery as well as postnatal care (Kurniati et al. 2018; Rizkianti et al. 2020). These findings highlight the importance of women's contribution and position within the household to health-seeking decisions.

At the individual level, the knowledge of pregnancy and delivery risks, recognition of pregnancy danger signs as well as the importance of skilled birth attendant presence during childbirth would increase health care-seeking behaviour. Previous studies show that women with higher awareness of pregnancy danger signs would be more likely to use SBA (Gage 2007; Phoxay et al. 2001; Stekelenburg et al. 2004). In addition, ANC use has also been associated with SBA use (Gage 2007; Sepehri et al. 2008) as during ANC, women would be more likely to be informed about their pregnancies and the possible complications. And also, ANC utilisation may indicate that women would already have better access to service delivery points. However, the nature of delivery is different with ANC, which is more flexible in timing and can be planned ahead. Therefore, some studies have also found that there is no association between ANC and skilled birth attendance (Gage 2007; Yanagisawa, Oum & Wakai 2006).

Perceived benefits also relate to previous exposure to health care services, the perception of the quality of available health services, including facilities and human resources. A pregnant woman with a prior bad experience with health care services or who has observed that available facilities or human resources for health were not adequate, might perceive that there would be little benefit from utilizing health services. This might be independent or not necessarily linked with the other positively correlated factors with SBA, such as their level of education, empowerment within the household or even the economic status of the women and the families.

Previous studies have shown that factors including maternal age, household wealth status and parental education have significantly contributed to the utilisation of MNH services, including SBA. A study by Navaneethan and Dhamalingam (2002) found that there is higher SBA coverage among younger women (<25 year old) compared to their older counterparts. Similar findings were also stated by Gleit et al (2003) in their Guatemalan study and also by Elo (2003) in a Peruvian setting. A possible explanation may relate to younger women being more receptive to health care services and also that older women relatively have higher parity and thus maybe feel more confident in delivering without professional health care assistance or have previously had bad experiences in past deliveries. It should be noted that other studies also found no correlation between maternal age and SBA use (Burgard 2004; Reynolds, Wong & Tucker 2006).

Maternal education is also strongly associated with SBA utilisation where women from a higher educational background are more likely to use SBA service compared to those with lower educational attainment (Bloom, Wypij & Gupta 2001; Furuta & Salway 2006; Li 2004; Movahedi et al. 2009; Phoxay et al. 2001). A study by McTavish et al (2010) also concluded that improving literacy level among women could reduce income-related inequalities in MNCH in Sub-Saharan Africa and that education was also associated with better income and living conditions (Singh-Manoux, Clarke & Marmot 2002). In Indonesia, women with high school education or higher were 10.12 times more likely to utilise ANC4+ compared to those with no education (Nababan et al. 2018). These correlations highlight the connection not only between better education and economic status, but also increased health knowledge particularly relating to the benefits of modern maternal health care, and more control over household resources and spending that can be used for the care of women and children through greater decision-making power for women within their households.

4. 4 Impact of health insurance on maternal health care utilisation

The impact of health insurance, as a form of user-fee reduction/removal programme, can be viewed in terms of better utilisation of key health services, financial protection from out of pocket and catastrophic health expenditures associated with the use of health services, and in terms of health outcome. Various researchers have shown that enrolment in health insurance schemes has led to an increase in the probability of using services generally (Wagstaff 2007; Wang, Temsah & Mallick 2017; Aggarwal 2010; Lagarde & Palmer 2008; Qin et al. 2019).

In terms of maternal health care services, key maternal health interventions are typically covered under the benefit package of most social health insurance schemes. However, as noted by Wang et al. (2017), few studies have used rigorous methods to assess the impact of insurance coverage on maternal health care service utilisation. Several existing literature using rigorous methodology have applied random control trial experiment, propensity score matching (PSM), difference-in-differences and instrumental variable methods (Comfort, Peterson & Hatt 2013; Anindya, Lee, McPake, Wilopo & Carvalho 2020; Aggarwal 2010; Wagstaff 2007). A study from Ghana that used PSM found that when compared to

uninsured women, insured Ghanaian women were more likely to access three or more ANC visits, have facility-delivery, use SBA, and receive postnatal visits as well as receiving early-childhood immunization for their children (Mensah, Oppong & Schmidt 2010). In terms of health outcome, the same study found that birth complications were less likely to occur among children whose mothers were insured.

Voucher systems as a form of financial protection and incentive for maternal health care have also been widely researched. Nguyen et al. (2012) utilized the difference-in-differences method and found that women in the intervention districts were more likely to use ANC, facility delivery and postnatal care. Similarly, a Colombian study by Giedion et al. (2007) that utilised PSM and difference-in-differences methods found that the voucher program managed to increase the utilisation of SBA and the coverage of complete immunization among children. It should be noticed as well, since the immunization program in Colombia is provided free by the government, the impact of the voucher program on immunization implies that the voucher program not only serves as a financial protection scheme but also as an incentive for women to access basic immunization services.

However, previous studies have also reported mixed findings relating to the impact of health insurance coverage on maternal health care use. An evaluation study using the PSM approach was conducted in one Indian province community-based health insurance (CBHI), which showed no changes in ANC utilisation or delivery in a private health facility after the introduction of the insurance program (Aggarwal 2010). The author stipulates that since normal deliveries in private settings have just been introduced at the time of the study, there was not enough period to observe a meaningful change.

Indonesia's financial protection programs for MCH and impact on MCH service utilisation

The first MNCH-specific financial incentive scheme was launched in 2007 under a program called *Program Keluarga Harapan* (PKH), which is a conditional cash transfer program aiming to increase MNCH service utilisation among low-income pregnant women and children (Ministry of Social Affairs 2020). The PKH program provided a cash incentive of IDR 800,000 (or around USD 66) for pregnant women under the condition that they receive the minimum required number of maternal health care services, including a minimum of 4 ANC visits during pregnancy, use of skilled birth attendant during delivery and two postnatal visits after child delivery. The PKH program also aims to improve the economic status of the households. The failure to access the care required would affect the amount of cash received by the women. However, there is no robust large-scale evaluation study on the PKH program and its effect on MCH service use. Small-scale studies conducted at the sub-district or district level have shown that the program has improved health awareness among women and their family but its impact on improvement in health care use is not well documented (Putri 2016; Prayitna, Nurhaeni & Demartoto 2018). Another study on PKH found only 0.9% reduction in the poverty rate with no improvement observed among the poorest households (Huzaipa 2014). To further the effort of providing financial protection and reduce maternal mortality in Indonesia, the government implemented the *Jampersal*

(*Jaminan Persalinan*) insurance scheme in 2011 that covered all pregnant women regardless of their socioeconomic status (Achadi et al. 2014).

The *Jampersal* expanded the delivery services by cooperating with both public and private practices that are able to provide maternal and delivery services. However, *Jampersal* program did not manage to address the disparities in the availability of maternal health care services, particularly in remote areas of Indonesia. A study using the 2012 Indonesia Demographic and Health Survey found that 8.8% of pregnant women in the poorest wealth quintile did not receive antenatal care, compared to only 0.2% of women in the richest quintile (Nababan et al. 2018). Furthermore, in terms of reducing out-of-pocket expenditure, studies by the UNFPA and the World Bank also found that *Jampersal* had no effect in reducing OOP among pregnant and delivering women and did not substantially improve the utilisation of key maternal health care interventions (UNFPA 2014). The UNFPA study also cited multiple barriers in the management and the implementation of the program, which are cited to be bureaucratic and cumbersome for health service providers. Another study by Achadi et al (2014) found that *Jampersal* insurance was mainly used among women with lower level of education, from low economic background and living in rural areas. In addition, women with delivery complications had also higher utilisation of the insurance program and the impact of the insurance on facility delivery was only significant in areas where institutional deliveries were still very low. However, Achadi et al.'s study was limited only to two districts in Indonesia.

During the start of the implementation of JKN in 2014, the *Jampersal* program was discontinued and the services covered under the *Jampersal* were incorporated into JKN, which include ANC services, facility-delivery, postnatal and neonatal care as well as family planning services. Under the JKN scheme, referral to higher-level facilities was also covered in cases of delivery with complications. More recently, *Jampersal* was re-introduced in 2016, now aiming to cover other costs related to MNCH services that would not be covered under the JKN scheme. These costs include transportation funds for referral cases and funds to assist families who accompany women for deliveries. Under the new program, *Jampersal* fund is disbursed directly from the Ministry of Health to district-level implementers who would then reimburse medical fees to both private and public providers who are cooperating for the *Jampersal* program (Ministry of Health 2019a). The reimbursement is based on non-capitation payment. However, based on a 2017 report from the Ministry of Health, most of the funds were not absorbed due to inefficient socialization of the program to the population as well as the health departments and facilities. In addition, bureaucracy has hindered the implementation, including because of the late issuance of the yearly *Jampersal* technical guideline that led district-level implementers to be unsure of the actual services that can be covered by the program and the technicality of the reimbursement processes.

JKN: impact on maternal and child health

In terms of the documented impact of Indonesia's health insurance on general health care use, several recent studies have attempted to document the effect of JKN on both inpatient and outpatient service utilisation. The most recent is the study by Erlangga et al. (2019) that used panel data dated from 2007-2014 with PSM and difference-in-differences approach to assess whether JKN has improved the access to general outpatient and inpatient care. Erlangga et al. found that JKN was associated with increased probability of hospital inpatient admission for both the subsidized and contributory groups of beneficiaries. However, the probability for inpatient admission was lower for the subsidized group (1.8%) compared to the contributory group (8.2%). Furthermore, the increase in the probability for outpatient service utilisation was only observed for the contributory group (7.9%) and not for the subsidized group. Such differences between the contributory and subsidized groups may also due to the inverse equity hypothesis (Neal et al. 2015; Adegbosin et al. 2019; Victora 2008; Boerma et al. 2018), where at the early stage of the JKN rollout, the population with higher socioeconomic status enjoyed greater benefits compared to their poorer counterparts.

The most notable limitation of the study relates to the panel datasets that were used for the analysis. The last set of the panel survey of the Indonesia Family Life Survey (IFLS) was conducted in September 2014 and early 2015, which may be too close to the start of the JKN implementation and may be affected by the rollout process of the beneficiaries. It should also be noted that the IFLS dataset used in the study did not cover all of the Indonesian provinces and excluded most of the eastern provinces, which are considered to be the less-developed region in the country (Strauss, Witoelar & Sikoki 2016). In other words, provinces included in the IFLS in general, are better off compared to non-IFLS provinces. And therefore, as noted by the authors as well, the results of the study may reflect more of the upper limit of the true impact of JKN. On the other hand, is worth noting that provinces not included in the IFLS have a larger proportion of poor population, who may have benefited more from a user-fee reduction policy such as JKN.

Other studies on Indonesia insurance schemes, including the JKN program, have utilised varying methods with mixed findings. A descriptive analysis using the Indonesian socioeconomic survey (Susenas) showed that JKN beneficiaries had a higher likelihood in using both outpatient and inpatient services compared to the uninsured population. However, since the analysis did not control for insurance status prior to the JKN implementation it may be sensitive to selection bias. Another study by Johar (2009) assessed the health cards program that was introduced in 2000 and found no changes in outpatient utilisation due to inelastic demand among the beneficiaries. Furthermore, Hidayat and Pokhrel (2010) assessed the impact of the Askes and Jamsostek programs (those for formal sector workers, that were eventually incorporated into JKN) and found a positive effect on outpatient utilisation. A more recent study by Sparrow et al. (2013) focused on analyzing the impact of the Jamkesmas that was targeted for the poor population and also found a positive correlation with outpatient care service utilisation.

Assessing the same program but with different datasets, Vidyattama et al. (2014) also found positive correlation of Jamkesmas on outpatient service utilisation.

One of the most recent publications on the impact of health insurance on maternal health care services in Indonesia is authored by Wang et al. (2017). It showed a positive impact of the insurance coverage on key maternal health services including antenatal care and institutional delivery. The publication used the IDHS 2012 dataset, which precedes the introduction of JKN program but still allows for the assessment of other health insurance programs on maternal health care. Wang et al. applied PSM methods in their study while categorizing the study population into those insured and uninsured. After matching using key confounders including maternal age, marital status, education level, employment status, the enrolment in an insurance program was shown to positively affect a number of key maternal health services. Having insurance coverage also increased the use of 4 visits of ANC by 2.6%, while the insurance coverage increased facility delivery use by 4.9% (p-value<0.001). However, the study did not include factors such as provider type and the health insurance characteristics of the enrolees, which could affect the level of health care utilisation. In addition, the cross-sectional nature of the survey also could not capture the changes in the women's insurance status, before or after the survey was conducted.

We found three studies that assessed the impact of JKN on population-level maternal health service use. A report by Teplitskaya and Dutta (2018) showed improvement in access to maternal health after the implementation of the JKN. Another study by Nasution et al. (2019) found JKN was associated with improved skilled birth attendance coverage (Nasution, Mahendradhata & Trisnantoro 2019). However, these studies used a simple before-and-after comparison without adjusting for underlying time trends. A more recent study by Anindya et al. (2020) using propensity score matching analysis provided a robust assessment and although JKN improved access to maternal health care services with greater effect among the poor, large differences in utilisation also persist across regions and by economic groups. However, the study used a cross-sectional dataset so did not assess the effect of JKN on mortality outcomes. So far, there is no robust study that has assessed the impact of JKN on access to essential maternal health services, neonatal and infant mortality, and its impact on socioeconomic and regional health inequalities in Indonesia. JKN is also a vast experiment in a population of 270 million people and its assessment offers the potential to inform health systems reform across the region and beyond.

Chapter 5: Overview of Data Sources and Methodology

There are four manuscripts in this thesis. The datasets used in the analyses for each of the chapter are presented in table 5.1 The first manuscript (Chapter 6) focused on assessing the demand and supply-side factors that drive geographical inequality in the use of skilled birth attendance, as such used data from the 2018 SUSENAS that is complemented with additional datasets from the 2018 National Medical Council registry and the Ministry of Health that contain information on human resources for health (doctors and midwives) as well as health facilities (hospital beds and primary health centres). The second manuscript (Chapter 7) uses data from four waves of the Indonesia DHS (IDHS), i.e. 2002/2003, 2007, 2012 and 2017. Finally, the third and fourth manuscripts (Chapter 8) evaluates the national health insurance impact on MNCH service use as well as the women's choice in health care providers. For the third manuscript, multi-year IDHS datasets were used while 2018 SUSENAS was used for the fourth manuscript (see Table 5.1).

Table 5. 1 Surveys and other datasets used in each thesis chapter

Chapter 6 (Manuscript 1)	Susenass 2018; Indonesian Medical Council database on number of doctors per district 2018; Ministry of Health database on number of midwives and hospital beds per district 2018
Chapter 7 (Manuscript 2)	Indonesia DHS 2002/2003, 2007, 2012, 2017
Chapter 8 (Manuscript 3 and 4)	Manuscript 3: Indonesia DHS 2002/2003, 2007, 2012, 2017; Manuscript 4: Susenass 2018

5. 1. Data Sources

Demographic and Health Survey (DHS)

The DHS is a household survey that collects information on socio-demographic and health indicators, including family planning service utilisation, maternal and child health services, malaria, and HIV/AIDS. The DHS project is funded by USAID and has been implemented for the last 35 years in more than 90 countries. The DHS typically covers 5,000 – 30,000 households per country and is generally repeated every 5-years. And thus, DHS provides useful information to monitor the trends in population health and the coverage of health interventions. As comprehensive vital registration does not exist for most LMICs, DHS is also often the only available nationally representative dataset that contains information on maternal and child mortality. In Indonesia, the DHS is generally repeated every 5-years. Similar to other LMICs, DHS fills in the gap in data availability on maternal, neonatal, infant and under-five child mortality in Indonesia.

DHS uses a multi-stage stratified cluster design and is representative at the national and provincial levels. The Indonesia DHS has a high response rate with a large sample size, as outlined in table 5.2 below.

Table 5. 2 Indonesia DHS household and individual interviews results

DHS Year	Household				Women interview		
	Household selected	Households occupied	Households interviewed	Response rate	Number of eligible women	Number of eligible women interviewed	Response rate
2002/2003	34,738	33,419	33,088	99.0%	29,996	29,483	98.3%
2007	42,341	41,131	40,701	99.0%	34,227	32,895	96.1%
2012	46,024	44,302	43,852	99.0%	47,533	45,607	95.9%
2017	49,261	48,216	47,963	99.5%	50,730	49,627	97.8%

The DHS uses a set of standardised questionnaires, which permits comparisons of surveys across time periods. The questionnaires available for Indonesia are as follow: (1) household questionnaire, (2) woman's questionnaire, (3) man's questionnaire and; (4) biomarker questionnaire. In the household questionnaire, information on the household characteristics includes the standards of living (e.g. source of drinking water and toilet facilities) and household assets. For members of the households, the following information are collected: age, sex, relationship to the head of the household, education, parental survival status and residence as well as birth registration.

For the individual interview, eligible individuals are women of reproductive age (15-49) and men age 15-49, 15-54, or 15-59. In this chapter, the focus is on the women's questionnaire as it contains the information used in the analyses within this thesis. The general topics covered in the women's questionnaire include the background characteristics of the women (age, marital status, education attainment, area of residence and other information that influence health behaviour). Information on reproductive behaviour was particularly important as they contain information on the survival status of all births, pregnancies histories, fertility preferences and future childbearing plans of each woman. Information on family planning or contraceptive use and intention to use are also collected. These include the knowledge and exposure to family planning information, informed choice and current use of various contraceptive methods as well as the source of the methods and unmet need for family planning. For women who were not using contraception at the time of the survey, information on the knowledge of family planning and source of contraception were collected.

For all births occurring within 5-years preceding each survey wave, women were asked about their antenatal, delivery and postnatal care histories. For ANC, detailed information was collected on the types of provider who provided the service, frequency and timing of the visits, the components of the ANC service received by the women. For the latter, these include whether the women were weighed, had their height, blood pressure, mid-upper arm circumference and fundus measured, received stomach and baby's heart examination, given blood and urine samples as well as received pregnancy consultation. Information on whether the women consumed iron tablets or syrup during pregnancy was also obtained to

assess whether the women adhered to the recommended clinical guideline for pregnancy management.

Histories on maternal delivery include the types of birth assistant, e.g. medical professionals, non-skilled attendant or no assistance during pregnancy. Women were also asked where they gave birth and consequently the postnatal services received. These include skin-to-skin contact, early breastfeeding, and medical examination performed on the newborn, e.g. measurement of weight and length, temperature check as well as the type of provider who performed the neonatal assessment.

From the women's questionnaire, complete birth histories for every child who has ever been born were also obtained. These include the birth date (date, month and year of birth), survival status (alive or not) and in the case of deceased children, the date of death. These particular information were crucial in calculating the NMR, IMR and U5MR from DHS datasets. For all children under-five, information on the child's immunisation was also gathered, which cover all vaccinations that were part of the national immunisation program.

The DHS developed the concept of recode files to facilitate data analysis. The recode files apply standard data definitions to allow for cross-countries comparisons as well as time-series analyses across DHS phases. Variables that are consistently recorded across DHS phases have the same across phases and countries. However, as the DHS questionnaires evolve over time, some recode definitions could be different for each phase. Some countries would also have specific additional questions, e.g. more details on types of contraceptive methods, that would not be available in other countries.

There are seven standard recode data files generated for the different questionnaires. For the use of this thesis, two recode files were used. These are the individual women's recode (IR) and the birth's recode (BR). The individual women's and birth's recode contain the household information, including the wealth index, type of residence, province or region of residence and other household's characteristics. The women's individual recode (IR) dataset was used to construct variables related to family planning service as it includes all eligible women regardless of their parity status. The birth's recode (BR) was used to construct all pregnancy and delivery-related variables as it contains information for all children of women born in the last 5 years preceding each survey wave.

Indonesia National Socioeconomic Household Survey (Susenas)

To address research objectives 2 and 3, the manuscripts used 2018 SUSENAS dataset. SUSENAS is a large survey that is designed to collect socio-demographic data in particular information related to health/nutrition, education, housing/environmental, sociocultural activities, consumption and household income as well as household welfare. SUSENAS is repeated yearly and covers all districts and provinces in Indonesia. In 2018 SUSENAS, more than 280,000 households and over 1.1 million individuals were included.

SUSENAS use two-phase sampling with separate sample selection for urban and rural areas. The sampling unit is called a census block, which is at the district-level and based on 2010

Indonesia population census. The first phase is done by selecting enumeration areas from the census block using probability proportional to size, in which the size is the number of households within each census block. The second phase is done by selecting 16 households from every selected census block. And finally, in order to capture new households or communities that were not included in the 2010 census, the Central Bureau of Statistics updated the list of households in each selected census block. The sampling methods of SUSENAS allow the data to have national coverage and be representative down to the district level. According to the SUSENAS field report, the response rate for the 2018 survey at the household level was at 98.3% (Central Bureau of Statistics 2019).

SUSENAS collects rich information at both household and individual levels. At the household level, information were collected on average household consumption, sources of household income and other characteristics, e.g. standards of living (types of toilet and sources of drinking water), types of residence (urban/rural) and place of residence (district and province). At the individual level, general descriptions were collected including the relationship to the head of household, sex, age, marital status, religion, ethnicity, education level and health information. The health information section is particularly important for this thesis as it contains details on maternal health care utilisation including histories on pregnancy and maternal delivery care. Fertility information and use of contraception for ever-married women were also collected.

There are three recode files for SUSENAS. First is the household-level recode files that contain pertinent information on the household's characteristics, e.g. size of the household, type of residence, etc. The second recode file is the household consumption expenditure that contains information on the expenses made at the household level on food, and non-food items. The non-food items also cover health expenditures. The third recode file is the individual data including for women samples that are included in this thesis. The details on pregnancy and delivery care were gathered from the individual recode file. In order to construct the necessary variables used in this thesis, all three recode files were merged using the unique household identifier. For instance, the per capita household expenditure was calculated based on (1) the size of the household available in the household recode file and the; (2) food and non-food consumptions made by each household from the household expenditure recode file.

Ministry of Health databases on health supply-sides

In addition to using the 2018 SUSENAS dataset, Manuscript 1 also used the Ministry of Health databases on health supply-side. These include the number of doctors and midwives at the district level; the number of hospital beds and primary health centres at the provincial level.

The database on human resources, i.e. number of doctors and midwives, included both public and private practitioners. Dual-practice of doctors is common in Indonesia (Mahendradhata et al. 2017; Meliala, Hort & Trisnantoro 2013; Anderson et al. 2014), and

using the information on the number of doctors practicing in each facility could lead to double-counting. And thus, in order to avoid this, I used the registration status of the doctors, which is issued by the Indonesian Medical Council for each doctor.

Data on the availability of hospital beds include both public and private hospitals. However, the completeness of the data reporting for hospital beds was approximately 78% (Mahendradhata et al. 2017) and could be higher for private hospitals that were not using the electronic reporting system connected to the Ministry of Health database. For the number of primary health centres, the idea was to capture the availability of health facilities that are equipped for providing maternal delivery services. Therefore, I only included the number of public primary health centres (*Puskesmas*) that have been accredited as able to provide standardised health services, including maternal delivery. Due to the lack of information on the service readiness level for private health clinics, I did not include the number of private health clinics as part of the analysis in Manuscript 1. This is to avoid the overestimation of primary health facilities that may not be able to provide maternal delivery services in the province.

5. 2. Measurement issues

The quality of data on child mortality

The outcome of neonatal and infant mortality is measured based on the information on whether a child who was born alive died within the first month or year, respectively, of life. In the DHS, the source of data on neonatal and infant mortality is retrospective birth histories, which were collected from all women aged 15-49 who participated in the surveys. For all live births, birth histories information includes the month and year of birth and the child's current survival status. Mothers whose children have died were asked to state the age at death. If the death occurred in the first 30 days of life, the age of death was recorded in days. And for death that occurred between 1 and 23 months for age 2 and younger, it was recorded in months (Bureau of Statistics Indonesia et al. 2013; Central Bureau of Statistics, National Family Planning Coordinating Board (BKKBN) & Inc. 2008; Central Bureau of Statistics Indonesia, National Population and Family Planning Board (BKKBN) & Calverton 2003; National Population and Family Planning Board (BKKBN) et al. 2018). While the true neonatal period is only the first 28 days of life, DHS considers deaths that occur in the first month to be in the newborn period (Pullum 2006), leading to possible misclassification of some of the neonatal deaths in this study. The decision by DHS was because the distribution of timing of deaths based on retrospective recall often shows a tendency for reports to be concentrated at key time points (such as one week, one month, etc). The difference between using 28 days and 1 month is then thought to be minor and unlikely to alter estimated effects of the determinants of the neonatal mortality rate (NMR). Data on birth histories that are collected through household surveys are currently the only nationally representative source of information on neonatal mortality for the nearly three-quarters of births that occur in countries without good coverage of vital registration system

(Mahendradhata et al. 2017), including in Indonesia. However, there are some important limitations of this method for estimating neonatal and infant mortality.

First is the possible underreporting of neonatal deaths that occur in the early hours or days after birth or the misclassification of neonatal deaths as stillborn (Bureau of Statistics Indonesia et al. 2013; Central Bureau of Statistics, National Family Planning Coordinating Board (BKKBN) & Inc. 2008; Central Bureau of Statistics Indonesia, National Population and Family Planning Board (BKKBN) & Calverton 2003; National Population and Family Planning Board (BKKBN) et al. 2018). For the Indonesian context, unfortunately, there is limited evidence that can be used to estimate the magnitude of the underreporting due to the limitation in the vital registration system. However, one study that compared the distribution of days since birth for neonatal deaths from DHS surveys against historical trends from death registries in England and Wales, found no evidence of underreporting of neonatal deaths in the first week of life compared to the rest of the neonatal period for the DHS estimates (Pullum 2006). The second concern is the selection bias, where only women who were alive during the DHS interview reported the survival status of their children, meaning that the children of mothers who have died will not be reported. As maternal and neonatal deaths have a positive correlation, this may lead to an underestimation of neonatal mortality, particularly when the MMR is high such as in Indonesia. The reporting of infant mortality could also be underestimated, although to a lesser degree. Previous studies have investigated this bias and suggested that the magnitude of this issue is minimal and still within the bounds of sampling errors of the DHS (Baqui et al. 2016; Fadel et al. 2017; Barros et al. 2005).

While there are limitations in the estimation of neonatal and infant mortality from DHS datasets, this thesis has used the best available data for Indonesia and still offers the opportunity to gain valuable insights in assessing disparities in child mortality in LMICs.

Measuring socioeconomic status in LMIC

Each chapter of this thesis involves measuring socioeconomic inequalities in various health outcomes. Central to the measurement of health inequalities is the choice of a relevant indicator of socioeconomic position. In high-income countries, income and expenditure levels are frequently used as indicators of wealth in measuring inequalities (Houweling, Kunst & Mackenbach 2003). However, household income is difficult to measure in LMIC settings where many people do not know their exact income and there is frequent non-cash exchange of goods and services (Rutstein & Johnson 2004). Income and other measures like household consumption and expenditures also tend to be quite variable over short periods of time (e.g., seasons) and are difficult and time-consuming to measure in household surveys (Rutstein & Johnson 2004). In LMIC settings, it has been shown that the assets households acquire can provide a good measure of longer-term household wealth (Houweling, Kunst & Mackenbach 2003). In the late 1990s, economists began to develop asset-based measures of economic status that would be more relevant to measuring the socioeconomic determinants of health in LMIC. These asset-based measures of household

wealth are now widely used to assess wealth-related inequalities for a variety of health outcomes (Houweling & Kunst 2010; Poirier, Grépin & Grignon 2020).

For the chapters that used the IDHS datasets, the analyses use the DHS wealth index, an asset-based index that measures permanent household wealth using information about household ownership of consumer goods (e.g., a radio, a bicycle, a telephone), housing quality (e.g., type of roof), and water and sanitation facilities (Filmer & Pritchett 2001). The use of asset-based wealth index offers several important advantages. Firstly is by providing a comparable and consistent economic gradient to that of per capita expenditure. As described in the paragraph above, the difficulties in obtaining robust information on income levels of the population in LMICs could be addressed by instead using the information on household assets that are frequently available in survey data. The asset index also tends to be able to identify more rural and smaller households than per capita expenditure measurement would as the index is highly correlated with urban-rural residence (Filmer & Scott 2008). This may partly reflect the inclusion of assets related to publicly provided services (e.g., water, electricity), which have much greater availability (often at lower cost) in urban areas (Rutstein & Johnson 2004). And therefore, asset-based wealth indices are widely utilised with largely consistent results compared to using household expenditure in the measurement of health inequality (Filmer & Pritchett 2001).

5. 3. Ethics of the study

This thesis did not seek a full review from an institutional review board as all analyses used secondary datasets that are publicly available and contain no personal identifications of the survey participants. The secondary datasets are publicly available from the following websites:

- The Indonesia Bureau of Statistics website (<https://microdata.bps.go.id/mikrodata/index.php/catalog/SUSENAS>) for the Susenas dataset;
- The MEASURE DHS website for the Indonesia Demographic and Health Survey datasets (<https://www.dhsprogram.com>) and;
- The Indonesia Ministry of Health publicly-open database (www.depkes.go.id).

Chapter 6: Explaining geographical inequality in maternal health care in Indonesia: a decomposition analysis (Manuscript 1)

Preamble

Equitable access to essential maternal and child health services is key to improving health outcomes. However, geographical disparities in the coverage levels of these services remain a challenge in LMICs and countries with large geographical variations and health systems readiness levels including in Indonesia. While various socioeconomic and demographic characteristics have been shown to contribute to the inequalities in health, it is also important to understand how factors within the health systems play a role towards the inequality. In particular, to understand the levels of contribution of the disparities in health supply-side factors across the regions in Indonesia toward the inequalities in MCH service utilisation.

In the following manuscript, I calculated the geographical gaps in the skilled birth attendance coverage across Indonesia regions. Using a decomposition approach, I assessed the relative contribution of health supply-side availability and other socioeconomic inequalities in geographical inequalities in skilled birth attendance utilisation.

Explaining geographical inequality in maternal health care in Indonesia: a decomposition analysis

Tiara Marthias, MD, MPH^{a, b}, Prof. Barbara McPake, BA, PhD^a, Dr. Michael Palmer, BC, P.G. Dip, PhD^{c, a}

^aNossal Institute for Global Health, The University of Melbourne, Melbourne, Australia.

^bDepartment of Public Health, Faculty of Medicine, Public Health & Nursing, Gadjah Mada University, Indonesia.

^cDepartment of Economics, The University of Western Australia, Perth, Australia.

Abstract

Background: Despite recent progress in improving access to maternal health services, the use of the services remained inequitable among women in LMICs. Further, significant geographical inequalities persist within countries. Previous literatures have explored the contributions of demand-side factors towards geographical inequality. However, few studies have assessed the importance of supply-side factors and the level of contributions towards geographical inequality in maternal health care use. This study aimed to i) measure the geographical inequality in skilled birth attendance in Indonesia and ii) examine both demand and supply-side that contribute to geographical gaps in the use of skilled birth attendance.

Methods: Using a rich collection of both demand and supply-side characteristics obtained from 2018 Indonesian national household survey data and administrative data, this study decomposes geographical inequalities in skilled birth attendance rates across regions in Indonesia using non-linear decomposition model.

Results: Skilled birth attendance coverage in the more prosperous region of Java-Bali was 7.4% higher than the rest of Indonesia. The gap was largest between Java-Bali and less developed region of Eastern Indonesia (20.1%) and smallest for Sumatra region (1.9%). Overall, half of the gap (59.8%) was attributed to differences in health system factors, particularly the availability of skilled health providers and hospital beds. Around thirty percent of the gap was attributed to differences in socioeconomic factors, particularly maternal education and household living conditions.

Conclusions: Findings suggest that strengthening of health systems and economic development in disadvantaged regions will narrow gaps in skilled birth attendant use across Indonesia.

Introduction

Achieving the Millennium Development Goals aimed at reducing maternal and child mortality proved challenging. Renewed efforts are now underway to reduce maternal, neonatal and child health (MNCH) inequalities in the post-2015 Sustainable Development Goals (United Nations 2016b). Key to this agenda is reducing geographical disparities in MNCH both within and across countries (Kassebaum et al. 2016). One of the key interventions in maternal health care is delivery attended by a skilled health professional, which has been proven to be critical in reducing maternal mortality (Bhutta et al. 2013; Alkema et al. 2016; Ronsmans, Graham, & Lancet Maternal Survival Series steering group 2006).

While the coverage of skilled birth attendance (SBA) has been increasing worldwide, significant disparities persist across and within countries. Between 2000-2006, 64% of deliveries were attended by SBA and this has increased to 81% by 2014-2019 (UNICEF 2020). However, the coverage rate varied across regions; Eastern and Southeast Asia have coverage of SBA at 99.7% and 76%, respectively, while it was only 59.9% in Sub-Saharan Africa. In many low- and middle-income countries (LMICs), within countries geographical disparities in the use of SBA also persist. According to a recent study conducted in 37 LMICs, SBA coverage in urban areas was at 80.0% compared to only 72.8% in the rural areas (2018) with a total of 33 out of 37 LMICs included in the study shown consistently lower coverage in rural areas. Significant urban-rural disparities were also found in the majority of countries, with the largest gaps were observed in the Central African Republic (32.8%) and Laos (19.6%).

In addition to urban-rural gaps, inequality in SBA use is also apparent across districts, provinces or regions within the countries. In Indonesia, an LMIC and the world's fourth most populous nation, only 86% of rural births were attended by SBA compared to 96% in urban areas in 2017. Further, less developed regions such as Papua had SBA coverage of only 62.5% compared to the capital province of Jakarta where 98.7% of births were attended by skilled health professionals (National Population and Family Planning Board (BKKBN), Health (Kemenkes), & ICF 2018). As the utilisation of key maternal health services significantly influences health outcomes (Bhutta et al. 2013), there are also significant variations in maternal health outcomes across provinces. In 2017, the maternal mortality ratio (MMR) in the less-developed region of Papua (380 per 100,000 live births) was double that of the national average (177 per 100,000 live births) (National Population and Family Planning Board (BKKBN), Health (Kemenkes), & ICF 2018). The failure of assessing and addressing the geographical disparities in access and use of key MNCH interventions have hindered Indonesia's effort in reducing its maternal and child mortality (World Health Organization 2019a). Further, Indonesia is currently ranked among the top ten countries globally for the number of under-five child and maternal deaths (Alkema et al. 2016). And thus, a greater

understanding of the factors driving geographical disparities in SBA is important to develop effective policies and strategies to address the gap.

In order to understand the factors contributing to geographical inequalities in the use of SBA, there is a need to examine all factors including the demand and supply-side variables. Past studies examining the geographical disparities in the use of MNCH services have generally found higher use of SBA in urban areas (Say & Raine 2007; Hodge et al. 2014; Titaley, Dibley & Roberts 2010) and in provinces or regions that are more developed (Nababan et al. 2018; Ruktanonchai et al. 2016; Martinez et al. 2011; Asamoah, Agardh & Cromley 2014). While studies on LMICs have examined which determinants contribute to the geographical inequalities and the levels of contribution towards the gap (Hodge et al. 2015; Ruktanonchai et al. 2016; Jimenez-Soto, Durham & Hodge 2014; Tripathi & Singh 2017; Shibre et al. 2020), the focus is mainly on the demand side factors with supply-side factors seldom included (Jimenez-Soto, Durham & Hodge 2014; Ruktanonchai et al. 2016). Supply-side factors, such as the availability of human resources for health and hospital beds, have been found to be important determinants of health care utilisation and health outcomes in many settings (Filippi et al. 2006; Goodman et al. 2002; Hotchkiss 2001).

Using a combination of national household survey and administrative data, this study examines a rich collection of demand and supply-side factors that contribute to geographical gaps in the use of skilled birth attendance (SBA) in Indonesia. We adopt a non-linear adaptation of the Oaxaca-Blinder technique to decompose gaps in SBA use between regions against a reference region of Java-Bali which contains the most developed provinces in terms of social determinants of health, public and health infrastructure, and availability of health facilities and human resources (Hodge et al. 2014). Understanding the extent to which differences in endowments across regions explain inequalities in MNCH utilisation is directly relevant to health policy aimed at narrowing MNCH inequalities.

Methods

Data source and study population

This study analysed data from the 2018 Indonesian National Socioeconomic Survey (SUSENAS), conducted by the Indonesia National Bureau of Statistics. The SUSENAS is a large, nationally representative household survey that collects detailed socioeconomic as well as health information including fertility, maternal and child health care service utilisation. The 2018 SUSENAS sample included 280,234 households (1,131,825 individuals). For the purpose of this study, we restrict to women aged 10-49 and focused on their most births within 2-years prior to the survey. After excluding incomplete observations (1.6%), our final sample size was 41,460 women.

The study also drew upon several datasets published by the Indonesia Ministry of Health which provide information on important supply-side variables, including the number of

hospital beds, doctors and midwives, and primary health centres at the district level in 2018. Specifically, this includes data on the total number of doctors and midwives; hospital beds and; primary health facilities (*Pusat Kesehatan Masyarakat* or Puskesmas) able to provide standardised services.

Measures

Dependent variable

Our primary outcome of interest was the skilled birth attendance (SBA), which was constructed using self-reported data from the women interview. Based on current guidelines for safe pregnancy in Indonesia, SBA is defined as having either a doctor or midwife assisting the delivery (MoH 2014). Births assisted by other types of paramedics or non-medical assistance (including traditional birth attendants and family members) are not categorized as utilising skilled birth attendance. The focus on SBA was chosen because the Indonesian government enacted a policy promoting skilled birth attendance at health facilities for all pregnant women (Indonesia MOH 2016) and is also an essential service to reduce maternal deaths and is part of the universal coverage agenda (Bhutta et al. 2013).

Independent variable

Our key independent variables are the health system variables including; (1) the availability of human resources denoted by the number of doctors and midwives; (2) health infrastructure as denoted hospital beds and the number of inpatient public primary health centers (Puskesmas) at the district level assessed as able to provide standardized primary health services. Puskesmas is a public primary health care facility with a set of mandatory services including maternal and child health services. A detailed description of the independent variables is provided in Appendix 2.

Explanatory variables

We utilised a collection of demand and supply-side variables to decompose regional disparities in SBA use in Indonesia. Demand-side variables, as obtained from the SUSENAS, comprising parental, household, and geographical characteristics. Parental characteristics include maternal and paternal education (categorical variable with categories 'no education', 'primary education', 'lower secondary education', 'higher secondary education' and 'post-secondary education'), maternal age (categorical variable with categories <20 years, 20-24 years, 25-35 years, >35 years), maternal marital status (married or otherwise) and health insurance coverage (with or no insurance coverage). Household expenditure is used as a proxy for permanent income (converted into per capita mid-year 2018 USD prices). Other household-level characteristics include sanitary and drinking source conditions. Geographical variables include the type of residence (rural and urban).

Empirical approach

We adopt a non-linear adaptation of the Oaxaca-Blinder decomposition technique to decompose regional inequalities in SBA use in Indonesia (Bauer & Sinning 2008; Fairlie 2005). Generally, the method is used to quantify the contribution of group differences in measurable characteristics to gaps in any continuous (and unbounded) outcome variable (Blinder 1973; Oaxaca 1973). Early applications included the decomposition of gaps in employment outcomes whereas more recent applications have extended to a range of fields, including health (Alvarez & Barranquero 2009; Chalasani 2012; Goli, Doshi & Perianayagam 2013). Typically, group differences include gender or race binary indicators yet may extend to geographical, time or other categorical differences in outcomes.

For the binary outcome case, ordinary least squares estimation yields inconsistent parameter estimates and, in turn, may result in misleading decomposition results. In this case, the estimation of nonlinear models is required. Following Fairlie (1999, 2005), the decomposition of a non-linear equation $Y = F(X\hat{\beta})$, where F is defined as the cumulative distribution function from the logistic distribution, which can be expressed as follows:

$$\bar{Y}^J - \bar{Y}^R = \left[\sum_{i=1}^{N^J} \frac{F(X_i^J \hat{\beta}^J)}{N^J} - \sum_{i=1}^{N^R} \frac{F(X_i^R \hat{\beta}^J)}{N^R} \right] + \left[\sum_{i=1}^{N^R} \frac{F(X_i^R \hat{\beta}^J)}{N^R} - \sum_{i=1}^{N^R} \frac{F(X_i^R \hat{\beta}^R)}{N^R} \right] \quad (1)$$

where $\bar{Y}^J$ is the average probability of SBA use for the region Java-Bali and $\bar{Y}^R$ is the average probability of SBA use for one of four region categories including Sumatera, Kalimantan, Sulawesi, and Eastern Indonesia (this includes Nusa Tenggara, Maluku and Papua); X_i represents a vector of demand- and supply-side observed characteristics for individual i in a given region; and $\hat{\beta}$ represent the estimated coefficients from the logit regressions for the respective region.

The first summand in the equation represents the proportion of the gap in the outcome that is attributable to differences in levels of observed characteristics across groups. It is the expected proportion by which the gap would close if people in the disadvantaged region had the same level of characteristics as people in the Java-Bali region. The second summand in the equation represents the proportion of the gap attributable to differences in the estimated coefficients of groups. Often dubbed the “unexplained” (versus “explained”) component, the second summand reflects the portion of the geographical gap in SBA use attributable to differences in returns of the characteristics as well as differences in unmeasured or unobserved endowments. Decomposition of the unexplained component is difficult to interpret (Fairlie 2005; Jones 1983). Instead, we instead focus on the decomposition of the explained component by individual characteristics noting only the aggregate gap attributable to the unexplained component which is useful to know. Decomposition of the contribution of individual characteristics to the explained gap is calculated as the change in the average predicted probability from replacing the reference

region (Java-Bali) distribution with the region of interest distribution of each variable while holding other variables constant.¹

Decomposition analysis of nonlinear models shares much of the same limitations as the original linear method. Most familiar is the sensitivity of results to the choice of the reference group. Neumark (1988) and Oaxaca and Ransom (1994) proposed a specification where the coefficient estimates from a pooled logistic regression of the reference region and region of interest are used as weights for the first term in Equation (1). In this paper, we present baseline decomposition results using the pooled coefficients as weights and test the sensitivity of our results using alternative weights of Java-Bali and 'other' regions coefficients. As recommended, we undertake further sensitivity analyses of our main specification in relation to the ordering of variables and the use of sample weights (Fairlie 2005). Regression estimates are weighted to reflect the complex survey design of the SUSENAS and standard errors are bootstrapped at 100 repetitions.

Results

Figure 1 and 2 map the coverage of SBA utilisation at the region and province levels, respectively. At the regional level, the average use of SBA decreases clearly from west to east with regions Sumatra and Java-Bali recording the highest average use at above 91% and Eastern Indonesia (Nusa Tenggara, Maluku and Papua) recording the lowest use at less than 80%. As shown in Figure 2, within regions, there exist significant inequalities in SBA coverage across provinces. In the decomposition analysis, we decompose inequalities in SBA use across regions against Java-Bali as the reference region controlling for provincial and other sources of variation. First, we present results on the underlying distribution (as described by the mean) and coefficients of the variables used in the main decomposition analysis.

Table 1 presents the sociodemographic characteristics and the availability of supply-side factors for the national sample and the five region sub-samples. As expected, there exist significant inequalities in characteristics across regions. Indicators of socioeconomic status follow a similar pattern to Figure 1 with the western regions of Java-Bali and Sumatra being the most advantaged and eastern regions the least advantaged. Almost 14% of women in Eastern Indonesia had no formal education compared to 4.3% and 6.3% in Java-Bali and Sumatra, respectively. Paternal education followed similar pattern. The national average for insurance coverage was 40.0% with the highest coverage in Kalimantan (45.1%) and lowest in Eastern Indonesia (30.8%). The average household size was larger in regions outside of Java-Bali (4.0) compared to the national average (3.8). The household consumption expenditure per capita was lowest in Eastern Indonesia (79.3 USD) and highest in

¹ Refer Fairlie (2005) for a detailed discussion.

Kalimantan (98.3 USD) followed by Java-Bali (92.4 USD). Lowest rates of having a flush toilet and protected water source usage were also recorded in the Eastern Indonesia region (55.6% and 54.6%). Java-Bali has the highest population density (6,053 per km²) and Eastern Indonesia the lowest (262 per km²).

The distribution of health supply-side indicators across Indonesia follows a similar pattern. On average, districts in Indonesia had 4,937 skilled birth attendants. Java-Bali region had substantially higher availability with an average of 8,717 skilled birth attendants per district. Regions with the lowest availability of skilled birth attendants per district were Eastern Indonesia (385) and Kalimantan (514). Hospital beds were also more concentrated in the Java-Bali region with an average of 30,363 beds per district compared to only 2,989 beds per district in Eastern Indonesia. The national average of *Puskesmas* per district assessed by the Ministry of Health as able to provide standardized primary health services was 384 with Java-Bali recording the highest number (568) and Kalimantan and Eastern Indonesia the lowest (95 and 63).

Decomposition estimates

Table 2 presents the results of the decomposition of the gap in SBA use between the relatively prosperous Java-Bali region and other regions in Indonesia. The results are based on decomposition analyses using pooled coefficient weights and the results from the logistic regression used as the basis of the decomposition models are available in Appendix 3. The gap was largest for Eastern Indonesia at 20.1% followed by 6.0% for Kalimantan, 5.8% for Sulawesi, and with a minimal gap for Sumatra region (1.9%). The average gap between Java-Bali and other regions in Indonesia was 7.4%. Of this, 87.3% of the gap can be explained by differences in underlying characteristics. This explained component was highest for Eastern Indonesia at 99.7% followed by Kalimantan at 78.0% and Sulawesi at 37.0%.

As shown in Table 2 (column 1), the factors which contribute most to the gap in SBA utilisation between Java-Bali and the rest of Indonesia are health system factors. Most notably, differences in the level of hospital beds explained 43.6% of the gap, and differences in the availability of skilled birth attendants (doctors and midwives) explained 22.2% of the gap. *Puskesmas* availability, on the other hand, did not significantly explain the observed gap. Together, differences in health system factors contribute 59.8% of the SBA utilisation gap between Java-Bali and the rest of Indonesia.

When comparing between Java-Bali and individual regions, however, the level of contribution of the differences in the health systems factors varied. For instance, the difference in the availability of hospital beds between Java-Bali and Sumatra contributed negatively to the observed gap (-38.9%). This was due to the negative coefficient for hospital beds variable in the logistic regression for SBA use in Sumatra (see Appendix 3). On contrary, the difference in hospital beds availability explained 83.8% of the observed gap between Java-Bali and Eastern Indonesia. This is due to the large difference in the absolute

number of hospital beds between these two regions and that hospital beds availability was positively correlated with SBA use in both regions. Puskesmas availability also largely explained the gaps between Java-Bali and most of the other regions; 26.4% for Sumatra, 82.7% for Kalimantan and 50.8% for Sulawesi. However, the contribution of differences in Puskesmas availability towards the gaps was negative for Eastern Indonesia, which implies that the mere number of Puskesmas in Eastern Indonesia did not contribute to a higher likelihood of SBA use in this region.

Differences in maternal education attainment contribute to approximately 9.2% of the gap between Java-Bali and other regions, which increases to 17.5% for the gap specifically with Kalimantan. Differences in indicators of wealth and economic development, including owning a flush toilet and population density, contribute to a further 11.7% of the gap between Java-Bali and the rest of Indonesia. Interestingly, differences in health insurance coverage only marginally (-0.3%) explained the gap in SBA use between Java-Bali and the rest of Indonesia and had a negative contribution in Sulawesi (-5.8%). The other remaining variables had a negligible contribution, including maternal age, marital status, paternal education, household size and household consumption expenditure per capita.

Sensitivity analysis

Decomposition results are sensitive to the choice of reference group weights, dubbed as the 'index number problem' (Oaxaca 1973). It is recommended that the sensitivity of results be tested against the use of alternate weights (Fairlie 2005). We tested the sensitivity of our baseline results based on pooled coefficient weights against alternate decompositions using Java-Bali and other regions' coefficients as the weights. As shown in columns 2 and 3 of Table 3, the estimate of the total explained gaps between Java-Bali and the rest of Indonesia ranges from 41.7% for Java-Bali regions coefficient weights to 116.7% for other regions coefficient weights compared to our baseline estimate of 87.3%. As can be seen in Table 3, the difference is driven primarily by differences in the contribution of the (log) skilled birth attendants variable due to different returns in Java-Bali and the rest of Indonesia (Appendix 3). This result supports the argument of using pooled coefficient weights to avoid discriminating in the choice of any one coefficient vector (Neumark 1988; Oaxaca & Ransom 1994). The pattern of remaining variable contributions is consistent across alternative reference weights, with differences in the availability of hospital beds accounting for the highest share of utilisation gaps.

Another potential issue regarding the non-linear decomposition relates to the ordering of the variables in the model (Fairlie 2005). In column 4 of Table 3, we present decomposition results for the Java-Bali region and rest of Indonesia comparison where the order of variables is reversed. Whilst there are some differences in the contribution of individual variables compared with the baseline results shown in Column 1, the total explained gaps between the two decompositions remains little changed (87.3% versus 87.4%). We also

tested several other changes in the ordering of variables and the results remain qualitatively unchanged.

We also decomposed the geographical gap in SBA use using the total number of *Puskesmas*, as opposed to the baseline decomposition that only included well-equipped or *Puskesmas* that are able to provide standardised services. As seen in column 6 of Table 3, the differences in the total number *Puskesmas* explained a negative 61.1%. This indicates that narrowing down the differences of the total number *Puskesmas* would actually increase the geographical gap between Java-Bali and the rest of Indonesia.

Finally, as recommended in the literature, we tested the sensitivity of our decomposition results with the use of sample weights (Fairlie 2005). As shown in column 5 of Table 3, the total explained gap for the decomposition with the use of sample weights is lower than the baseline results adjusted for the complex survey design (79.9%). The difference stems largely from larger positive contributions of the (log) *Puskesmas* availability to the weighted gap. As noted by Fairlie (2005), the issue of sample weights is due to the index problem which we mitigate through the use of pooled coefficient weights. While the levels of contribution of different variable changes depending on the weighting used, we observed positive explained gaps in the baseline and all sensitivity analyses. This indicates that the sum of the components contributes to a widening of the geographical gap, rather than narrowing.

Discussion

Overall, our results document significant inequalities in the use of a SBA between Java-Bali and the rest of Indonesia, particularly in the Eastern regions of Nusa Tenggara, Maluku and Papua. The utilisation gap between the Java-Bali and other regions of the country is 7.4% which triples for the Eastern Indonesian region. Almost all of the observed gap between Java-Bali and other regions (87.3%) can be attributed to differences observable characteristics across regions when controlling for a wide range of demand and supply-side characteristics including demographic, human capital, living standards, wealth, urban development, and health care human resources, services and infrastructure characteristics. For the region-specific comparisons with Java-Bali, differences in underlying endowments account for between half to three-quarters of utilisation gaps. For the relatively disadvantaged region of Eastern Indonesia, 99.7% of the gap was explained.

Our results suggest that regional differences in health care system factors were the most important determinant of SBA utilisation gaps, which represents a new finding in the literature. Differences in levels of quality primary health care facilities at local levels across Indonesia contribute most significantly to geographical utilisation gaps. *Puskesmas* is the backbone of primary health services in Indonesia, with better service provision capacity compared to private clinics (Rajan et al. 2018). However, *Puskesmas* service standards vary

greatly across the country; only one-third have beds and few have basic emergency obstetric care with trained health staff available. In eastern regions of the country, *Puskesmas* typically only provide basic health services and often are not fully staffed or have intermittently one auxiliary paramedic (Mahendradhata et al. 2017). To capture differences in service readiness and quality at the primary level, we used a measure of *Puskesmas* supplied by the Ministry of Health which assesses the facility as sufficiently equipped to provide standardized services. Using this measure of equipped *Puskesmas*, differences in the availability of primary care facilities account for over one quarter (26.4%) of the regional gaps in SBA use between Java-Bali and Sumatra, and over 80% of the gap in Kalimantan specifically. When we use an alternate measure of the total number of *Puskesmas* the variable contributed *negatively* to the overall gap, as shown in Table 4 (column 7). Whilst the absolute number of *Puskesmas* was higher in Java-Bali compared to other regions, the variable was negatively correlated with SBA use and thus, contributed negatively to the overall gap (results not shown). Together the results suggest the physical presence of primary health care centres matters less than the ability of *Puskesmas* to provide quality services as to whether mothers access an SBA, consistent with the findings of other studies (Afsana & Rashid 2001; Rajan et al. 2018).

As expected, regional differences in the availability of skilled-birth attendants, as measured by the number of doctors and midwives at district level, further contributed to inequalities in SBA utilisation in Indonesia. Java-Bali region had the highest number of skilled birth attendants compared to the rest of Indonesia. The strong correlation between the availability of health human resources and the use of SBA suggests that if the rest of Indonesia had the level of SBA human resources of Java-Bali the utilisation gap would decrease by 22.2%. The result is mostly driven by Eastern Indonesia where there exists the lowest number of SBAs. Java-Bali region also had almost triple the number of hospital beds compared to the other regions, which explained 43.6% of the disparity in the use of SBA. Together, differences in the levels of equipped primary health care facilities, skilled-birth attendants and hospital beds explained close to 59.8% of the regional gaps in the use of SBA between Java-Bali and the other regions. The finding is in line with wider literature on the importance of health supply-side factors in health care utilisation (Filippi et al. 2006; Goodman et al. 2002; Hotchkiss 2001; Kanchanachitra et al. 2011). Our findings imply further that investments in health system strengthening will yield the greatest returns in reducing regional inequalities in maternal care utilisation in Indonesia.

Among household characteristics, lower levels of human capital attainment among mothers in regions outside of Java-Bali was among the most important determinant of gaps in SBA utilisation. Consistent with other studies, we find a strong positive association between maternal education and the likelihood of using an SBA across regions (Alam et al. 2015; Falkingham 2003; Fang et al. 2010; Say & Raine 2007). Effects were strongest at higher education levels which suggest gains in narrowing SBA utilisation gaps can be achieved

through addressing inequalities in both primary and secondary school attainments. This particularly relates to the disadvantaged region of Sulawesi where the raising of female education attainment to Java-Bali levels would decrease the utilisation gap by 15.1%. We did not find any significant effect of differences in paternal education as contributing to regional SBA utilisation gaps because it is less strongly correlated with SBA use. The findings suggest that improvement in female education will narrow inequalities in SBA use across the country.

The lower level of economic development in regions outside of Java-Bali contributes further to regional SBA utilisation gaps. As a proxy for household wealth, we found lower levels of flush toilet ownership in regions outside of Java-Bali as a significant contributor to SBA utilisation gaps. Consumption expenditure matters less than wealth which may relate to the stock versus flow nature of these variables (Deaton 1997). We found that the lower share of urban population in regions outside of Java-Bali contributes positively to SBA utilisation gaps. As urban areas may reflect general macroeconomic development and accessibility to health care services, the result is not surprising and lines up with reports of the health system in Indonesia as being mainly concentrated in urban areas as well as the wider empirical literature which establishes urbanization as a key determinant of health care utilisation (Guliani, Sepehri & Serieux 2013; Ruktanonchai et al. 2016; Say & Raine 2007; Titley, Dibley & Roberts 2010; Viegas Andrade et al. 2012). Overall, findings suggest that convergence in economic development across Indonesia will contribute to narrowing gaps in SBA utilisation.

Whilst differences in endowments of the above factors provide valuable insight into what explains regional SBA utilisation gaps, a portion of the gap remains unexplained. This particularly concerns gaps between Java-Bali and Sumatra, Kalimantan and Sulawesi regions where the unexplained components were 91.1%, 22.0% and 63.0%, respectively. The portion of the gap not attributable to differences in underlying levels of observable characteristics result from different returns to observable characteristics and unobservable characteristics across regions. Although our list of control variables is extensive, the variables are unlikely to fully capture regional variations in the use of SBA as relates to important factors such as geographical accessibility, quality of care and cultural factors. Further, our models were less able to explain the differences between Java-Bali and Sumatra and Sulawesi. This was due to the smaller difference in the coverage of SBA between Java-Bali (the reference group) and Sumatra (1.9%) and Sulawesi (5.8%). In comparison, the differences were much larger for the other regions, e.g. the difference in SBA coverage between Java-Bali and Eastern Indonesia was 20.1%.

Our results are robust to a range of sensitivity tests however some caution is warranted. The primary purpose is to describe whether differences in observable characteristics explain regional gaps in SBA utilisation. Our decomposition analyses are correlations only and do not make any claims on causality. In addition, whilst the SUSENAS survey is nationally

representative down to the level of the district it is likely to have limited representativeness of people living in the most remote areas which will bias our results towards zero. Furthermore, the health care data utilised in this study is drawn from routine Ministry of Health report databases which may be incomplete or subject to reporting error. Finally, women's self-report on the types of cadre of birth attendant may also pose some limitations. For instance, a study in Kenya found that women tend to overreport attendance by skilled providers as well as attendance by doctors or other higher-ranked health providers (Blanc, Warren, et al. 2016). However, a recent study by Radovich et al (2019) showed that while women have difficulties in identifying specific cadres, the population-based survey could reasonably estimate the overall coverage of SBA as was done in this study.

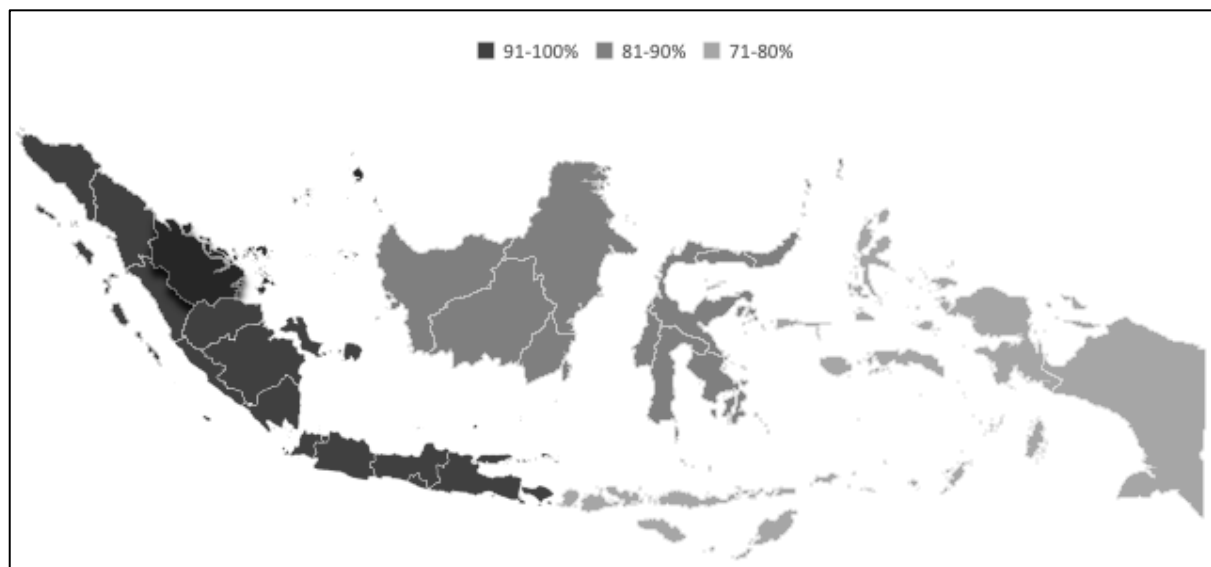
Conclusion

In this paper, we decomposed inequalities in regional SBA use in Indonesia using a non-linear decomposition method. This is the first study to deconstruct regional inequalities in SBA use in Indonesia that includes not only socioeconomic and demographic characteristics but also a wide range of health supply-side factors, encompassing both human resource and health facility variables.

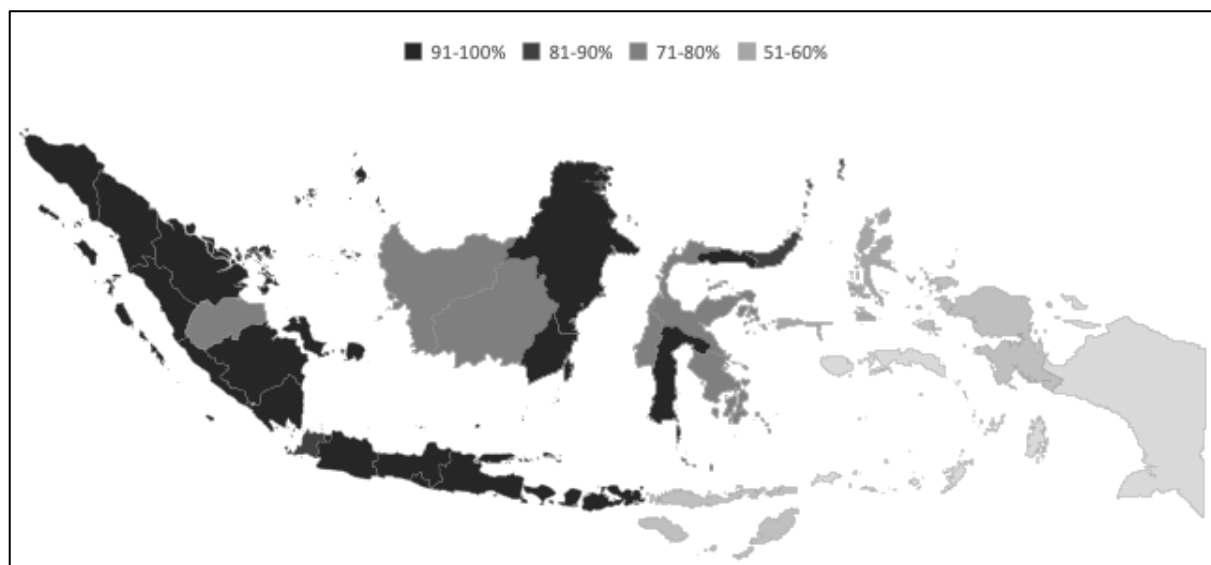
Findings indicate that there exist significant inequalities in SBA utilisation across regions in Indonesia compared with the relatively developed Java and Bali region with the largest gaps observed in the Eastern Indonesia region. Most of the observed gaps can be attributed to differences in observable characteristics across regions with differences in health system factors being the most significant determinant. Specifically, differences in the number of hospital beds, skilled health workers and primary health care facilities (*Puskesmas*) able to provide standardized services (with varying degrees) explain over half of the SBA utilisation gap between Java-Bali and other regions.

Our findings offer several considerations for policy makers. Increasing the coverage of adequately staffed and service-ready primary health care facilities in less resourced regions will contribute to narrowing regional gaps in maternal health care utilisation in Indonesia. As part of broader health system strengthening, this can be enhanced by increasing the number of doctors and midwives, and hospital beds, at both primary and secondary levels. In addition, investment in female human capital and economic development in disadvantaged regions of the country will further contribute to narrowing geographical inequalities in maternal health care utilisation.

Manuscript 1 Figure 1. Skilled birth attendance by region in Indonesia, 2018



Manuscript 1 Figure 2. Skilled birth attendance by province in Indonesia, 2018



Manuscript 1 Table 1. Descriptive statistics, by region

Variables	Region						
	Indonesia	Java-Bali	Non Java- Bali	Sumatra	Kalimantan	Sulawesi	Eastern Indonesia*
Maternal Education							
None	6.7	4.6	9.2	6.3	10.0	11.6	13.8
Primary	21.0	21.7	21.3	17.6	24.7	21.7	23.0
Secondary	57.2	60.6	51.9	58.9	51.3	48.8	43.1
Post-secondary	15.2	13.2	17.6	17.2	14.1	17.8	20.1
Insurance status							
No insurance	60.0	59.6	60.7	57.5	54.9	64.7	69.3
Has insurance	40.0	40.4	39.3	42.5	45.1	35.3	30.8
Maternal age							
< 20 years old	5.2	5.1	5.4	3.8	6.7	8.1	6.1
20-24 years old	25.6	26.6	24.6	23.4	25.6	26.6	25.0
25-35 years old	52.1	51.8	52.6	56.0	50.0	47.6	50.0
36+ years old	17.0	16.6	17.5	16.8	17.7	17.6	18.9
Maternal marital status							
Not married	1.8	1.6	2.0	1.5	1.5	2.4	3.1
Currently married	98.2	98.4	98.0	98.5	98.5	97.6	96.9
Paternal education							
None	7.1	5.4	9.0	6.5	9.3	11.0	13.6
Primary	22.2	23.2	23.2	19.7	22.4	22.0	23.4
Secondary	57.4	58.6	58.6	60.4	54.1	53.1	48.1
Post-secondary	13.4	12.9	12.9	13.4	14.3	13.9	14.8
Household size	3.8	3.6	4.0	4.0	3.9	4.1	4.1
Per capita household expenditure (USD)	88.4	92.4	83.9	82.7	98.3	80.6	79.3
Type of toilet							
Pit and others	32.8	28.8	37.3	36.4	37.9	31.7	44.4
Flush toilet	67.2	71.3	62.7	63.6	62.1	68.3	55.6
Source of drinking water							
Unprotected sources	23.2	14.8	32.7	28.6	35.5	28.4	45.4
Protected sources	76.8	85.3	67.3	71.5	64.5	71.7	54.6
Type of residence							
Rural	51.5	39.5	64.9	62.6	56.5	67.9	74.5
Urban	48.5	60.5	35.1	37.4	43.5	32.2	25.5
Population density (per km2)	4,937.0	8,717.7	737.8	803.6	706.5	897.1	399.5
Human resource (SBA)**	982.6	1,252.7	680.9	905.2	424.5	514.0	385.2
Hospital beds**	19,267.5	30,363.1	6,970.4	9,207.4	4,157.2	6,572.1	2,989.2
Puskesmas providing standard services**	384.2	568.9	179.4	227.1	95.2	219.6	63.3

*Includes regions of Nusa Tenggara, Maluku and Papua

**absolute number

Manuscript 1 Table 2. Decomposition of SBA use gaps between Java-Bali and other regions

	(1)		(2)		(3)		(4)		(5)	
	Java-Bali vs the rest of Indonesia		Java-Bali vs Sumatra		Java-Bali vs. Kalimantan		Java-Bali vs. Sulawesi		Java-Bali vs. Eastern Indonesia	
Decomposition estimates	Coef.	(%)	Coef.	(%)	Coef.	(%)	Coef.	(%)	Coef.	(%)
Maternal education	0.007***	9.2	0.005***	7.5	0.011***	17.5	0.009***	15.1	0.012***	6.2
Maternal age	0.000	0.0	0.000	-0.7	0.000	-0.5	0.000	0.3	0.000	0.2
Maternal marital status	0.000**	0.4	0.000	0.1	0.000	0.3	0.000	0.2	0.001***	0.6
Maternal insurance status	0.000*	-0.3	0.000*	0.7	0.003***	5.3	-0.003***	-5.8	-0.001**	-0.3
Paternal education	0.000	0.5	0.000	0.8	0.001	1.7	0.001	1.8	0.001	0.4
Household size (average)	0.000	0.4	0.000	0.5	0.000	0.3	0.000	-0.1	0.002**	0.9
Per capita household expenditure (ln) (USD)	0.000	0.0	0.000	-0.1	0.000	-0.7	0.000	0.6	-0.001*	-0.4
Flush toilet	0.003***	4.2	0.002***	3.3	0.003***	4.4	0.001**	1.0	0.006***	3.2
Protected drinking water	0.006***	7.5	0.003***	5.4	0.005***	7.9	0.003***	5.1	0.008***	4.0
Urban-rural	0.004***	5.8	0.003***	5.4	0.004***	7.4	0.006***	10.6	0.009***	4.4
Human resource (SBA) (ln of absolute number)	0.016***	22.2	-0.001	-1.5	-0.011**	-18.6	-0.013***	-21.7	0.036***	17.7
Hospital beds (ln of absolute number)	0.032***	43.6	-0.023***	-38.9	-0.018	-29.8	-0.012	-20.7	0.169***	83.8
Puskesmas able to provide standardized service (ln of absolute number)	-0.004	-6.0	0.016***	26.4	0.050***	82.7	0.029***	50.8	-0.042*	-21.0
Total explained	0.065	87.3	0.005	8.9	0.047	78.0	0.021	37.0	0.201	99.7
Total unexplained		12.7		91.1		22.0		63.0		0.3
Difference	0.074		0.019		0.060		0.058		0.201	

***p<0.01, **p<0.05, *p<0.1.

Manuscript 1 Table 3. Sensitivity analyses for decomposition of SBA use gaps between Java-Bali and the rest of Indonesia

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	Java-Bali weights	'Other' region weights	Reversed order variables	With sample weights	Absolute number of Puskesmas
	(%)	(%)	(%)	(%)	(%)	(%)
Maternal education	9.2	13.7	6.7	0.0	9.4	9.1
Maternal age	0.0	0.1	-0.1	0.0	0.1	0.0
Maternal marital status	0.4	0.7	0.3	0.4	0.5	0.4
Maternal insurance status	-0.3	-1.0	-0.1	-7.7	-0.9	-0.2
Paternal education	0.5	3.0	0.5	-1.7	1.4	0.5
Household size (average)	0.4	1.1	0.3	0.9	0.4	0.4
Per capita household expenditure (ln) (USD)	0.0	-0.1	0.2	0.1	0.2	0.0
Flush toilet	4.2	4.1	3.7	10.8	2.3	3.7
Protected drinking water	7.5	3.1	7.4	20.0	6.6	8.0
Urban-rural	5.8	10.3	5.4	13.6	5.7	6.3
Human resource (SBA) (ln of absolute number)	22.2	-43.0	34.6	26.8	8.8	50.8
Hospital beds (ln of absolute number)	43.6	39.7	44.9	26.7	24.9	52.1
Puskesmas able to provide standardized service (ln of absolute number)	-6.0	10.1	12.9	-2.6	20.4	
Total Puskesmas (ln of absolute number)						-61.1
Total explained (%)	87.3	41.7	116.7	87.4	79.9	69.9
Difference	0.074	0.074	0.074	0.074	0.074	0.074

Chapter 7: Distributional pathways towards high coverage levels of reproductive, maternal and child health interventions in Indonesia, 2002-2017 (Manuscript 2)

Preamble

In addition to ensuring equitable access to health services, one of the important aspects of UHC is the quality of care. Health interventions should not only be assessed by coverage but also by the extent to which they produce optimal health gains for the population. In the last chapter, it was shown that the overall coverage for skilled birth attendance in Indonesia is high and this was also the case for most of RMCH interventions, as presented in Chapter 3. However, the persistently high maternal and child health burden in Indonesia calls for further evidence on the quality of these services. Furthermore, it is important to provide continuous monitoring on the progress towards equity in access to quality RMCH service utilisation.

The expansion of RMCH interventions may also differentially benefit the more advantaged population. This is particularly the case during the initial stage of the scaling up of the interventions, where at low levels of overall coverage only the most advantaged population groups could enjoy the services. Therefore, inequality in health should also be monitored in relation to the distribution of the services.

In the next manuscript, I focused on two important factors in achieving UHC. First is the assessment of the current situation and trends in RMCH service coverage by considering the quality aspect of the services. And second, to understand the pattern or pathway towards high coverage levels and how provinces in Indonesia may scale up the interventions more equitably in the population.

Distributional pathways towards high coverage levels of RMCH interventions in Indonesia, 2002-2017

Tiara Marthias, MD, MPH^{a, b}, Prof. Barbara McPake, BA, PhD^a, Alison Morgan, MD, PhD^a, Natalie Carvalho, PhD^c, Likke Prawidya Putri, MD, MPH^b, Prof. Ova Emilia, MD, PhD^d, John Tayu Lee, PhD^a

^aNossal Institute for Global Health, The University of Melbourne, Melbourne, Australia.

^bDepartment of Public Health, Faculty of Medicine, Public Health & Nursing, Gadjah Mada University, Indonesia.

^cCentre for Health Policy, School of Population and Global Health, The University of Melbourne, Australia.

^dFaculty of Medicine, Public Health & Nursing, Gadjah Mada University, Indonesia.

ABSTRACT

Introduction

The Sustainable Development Goals (SDGs) emphasises the equitable distribution of quality health care services. This study aims to assess the current situation and trends over time in reproductive, maternal and child health (RMCH) service coverage in Indonesia using the effective coverage framework. We also seek to understand potential pathways towards high coverage levels with respect to the distribution of these services.

Methods

Using the 2002-2017 Indonesia Demographic Health Survey datasets, we estimated the trends in effective coverage of four essential RMCH services, i.e. family planning, antenatal care (ANC), maternal delivery service and childhood immunisation. Indicators of need, use and quality were calculated using a cascade care framework, which include (1) *service contact*; (2) *crude coverage*; (3) *quality-adjusted coverage* and; (4) *user-adherence-adjusted coverage*. Concentration indices, calculated at national and provincial levels, were plotted within each province against the level of service coverage to see how inequality level corresponds to coverage in each province.

Results

All RMCH service coverages increased between 2002 and 2017, however, the levels of quality-adjusted and user-adherence-adjusted coverage remained markedly lower than service contact and crude coverage. Despite a general reduction in economic inequalities between 2002-2017, large gaps between regions persist. We found pro-rich coverage for all types of RMCH services with the highest inequalities found for quality-adjusted and user-adherence-adjusted coverage. Antenatal care and maternal delivery services were more inequitably distributed in the population compared to family planning and childhood immunisation. Provinces with similar levels of overall coverage demonstrated very different results for equity, implying different pathways towards high coverage levels with respect to the distribution of the services.

Conclusion

Effective coverage of key RMCH services remains low, indicating that individuals are not receiving the optimal health gain from existing health services. There is an urgent need to focus on the quality and equity of RMCH services in Indonesia to achieve the SDGs for health.

INTRODUCTION

Indonesia, the fourth most populous nation of 270 million, spread across 34 provinces and around 13 000 islands, suffers from poor reproductive, maternal and child health (RMCH) outcomes. In 2017, there were an estimated 177 maternal deaths per 100 000 live births, 70 percent higher than the Millennium Development Goal for 2015 of 102, and one of the highest rates among neighbouring countries in Southeast Asia (World Bank 2020d). While Indonesia has made significant progress in reducing under-five mortality (25.9 per 1,000 livebirths), the infant mortality rate remains high at 21 per 1,000 livebirths and notably higher than neighbours Thailand (8) and Malaysia (7) (World Bank 2020e). There are also large socioeconomic and regional inequalities. For example, the eastern Indonesian province of Papua experiences much higher levels of maternal mortality compared to the national average, at 380 deaths per 100,000 live births in 2017. The Sustainable Development Goals [SDG] include ambitious targets (3.1 and 3.2) of reducing the global maternal, neonatal and under-5 child mortality to less than 70 maternal deaths per 100 000 live births, 12 and 25 neonatal and under-5 deaths respectively per 1000 live births by 2030.

One of the important aspects of UHC is the quality of care. Interventions need not only be assessed by coverage but also by the extent to which they produce optimal health gains for the population. Within the context of RMCH, one useful approach to monitor this is the effective coverage (effective coverage) care cascade framework. Developed by Evans et al., the effective coverage framework is based on the idea that a comprehensive assessment of health service delivery should incorporate measurement of the completeness of services received and the quality of the service, as an intermediate step to measure the impact of a health intervention (Evans 2003). Shengelia et al. (2005) proposed the definition and framework of effective coverage that could explain the gaps in health service delivery. The effective coverage framework has been used to assess health service coverage for several health conditions and interventions, including non-communicable diseases, malaria, childhood illness, surgery, as well as in assessing the performance of countries' health systems (Shengelia et al. 2005; Rupani, Gaonkar & Bhatt 2016; Galactionova et al. 2015; Ng et al. 2014; López-López, Gutiérrez-Soria & Idrovo 2012; Ozgediz et al. 2009; Lozano et al. 2006).

More recently, Amouzou et al. (2019) and Marsh et al. (2020) presented an effective coverage framework within the RMCH context, which proposed a six-step coverage framework, starting from a target population, and progressively evaluating (1) service contact, or the proportion of the target population who visited a health service; (2) likelihood of service, or the proportion who visited a health provider or facility that has the capacity to deliver the needed service; (3) crude coverage, or the proportion of the target population who utilised the needed service ; (4) quality-adjusted coverage, or the proportion of the target population that received the health service according to recommended clinical standards; (5) user-adherence-adjusted coverage or the proportion of

the target population that received services according to recommended clinical standards and adhered to treatment guidelines and finally; (6) outcome-adjusted coverage, or the proportion of the target population that experience expected health gains from the health service. Apart from its simplicity in terms of assessing health-system performance across the RMCH continuum of care, a key advantage of the effective coverage approach is that it offers a standardised approach to identify the losses of potential health benefits or gaps that can occur at each step of the coverage cascade. This allows for determining which health systems challenges require immediate attention or which sub-population requires more resources. Examples of growing interest in this approach include current recommendations of WHO and UNICEF to use it for RMCH as part of health system performance evaluation and monitoring of universal health coverage (UHC) (Evans 2003).

Health equity is also central to the SDGs and the World Health Organisation has stated that monitoring progress towards Universal Health Coverage (UHC) must also assess the equitable distribution of service and financial protection across socioeconomic and demographic strata (World Health Organization & World Bank Group 2014). Assessing the different pathways towards UHC is important to learn how RMCH services can be developed in a way that minimises disparity. As stated by Channon et al. (2013) the majority of countries that have achieved high coverage levels of maternal health services from a relatively low baseline level progressed through a common pathway. The coverage has first increased among the richer population living in urban areas following by the rural rich and urban poor population and lastly, the rural poor. As a result, equity would only be achieved after countries reach very high coverage. In a more recent analysis by Neal et al. (2015), while marked inequities in access to maternal health services were found among countries with low to moderate coverage, several countries have progressed more equitably. For instance, in Cambodia, even at the low baseline level of SBA coverage (30-49%), the increase has been primarily concentrated among the poorest quintile. And according to the projection it that study, such progress would mean that Cambodia will achieve the 80% target in 2030 for the country as a whole as well as for those in the poorest quintile (Neal et al. 2015). This implies that while unusual, some countries with extremely low coverage can in fact improve their coverage more equitably and that the pathway to UHC is not always through risking equity in access to health services.

Indonesia has invested substantially to improve standards and reduce variations in health care for RMCH. These include community-level interventions that attempt to integrate RMCH services through 'Integrated Health Posts' [*Posyandu*]), which have been successful in improving child nutritional status (Andriani, Liao & Kuo 2016; Anwar et al. 2010). The Indonesia village midwife program has also been associated with better coverage of antenatal care as well as skilled birth attendance (Frankenberg et al. 2009) More recently, the Indonesian government launched a financial protection program that allowed free-of-charge RMCH services for all Indonesian women and children called the Jampersal (*Jaminan*

Persalinan or Delivery Insurance) (E. Achadi et al. 2014). In 2014, the Jampersal was eventually absorbed into the National Health Insurance program, which is now the largest single-payer social health insurance scheme in the world. With the combination of the programs described above, among others, Indonesia has made progress in key RMCH indicators. Between 1990 and 2020, the use of modern contraceptives and DPT-3 immunisation has increased from 47% and 51% to 57% and 77%, respectively. For maternal health, 91% of women received at least four ANC visits in 2017— a notable increase from 55% in 1991. Likewise, skilled birth attendance coverage has also increased, by 60% within the last decade (Central Bureau of Statistics Indonesia et al. 1992; National Population and Family Planning Board (BKKBN), Statistics Indonesia (BPS), Ministry of Health (Kemenkes) & ICF 2018). However, health inequalities within the country persist where more developed provinces have consistently had higher service coverage and better health outcomes.

Our study considers two important factors in achieving UHC. First is to assess the current situation and trends over time in RMCH service coverage in Indonesia using the effective coverage framework. This would allow the identification of gaps along the RMCH effective coverage cascade. And second, we seek to understand potential pathways towards high coverage levels with respect to distribution by analysing equity at different stages towards high quality in different provinces at different times.

METHODS

Data and study sample

Data were obtained from nationally representative repeated cross-sectional surveys, the Indonesia Demographic Health Survey (IDHS). The IDHS is a household survey that collects data on reproductive, maternal and child health (ICF 2018; National Population and Family Planning Board (BKKBN), Statistics Indonesia (BPS), Ministry of Health (Kemenkes) & ICF 2018). Four rounds of the IDHS (2002/2003, 2007, 2012 and 2017) were analysed. The IDHS program applied a multi-stage stratified design to generate a nationally representative sample of women ages 15-49 years [DHS, 2018]. In IDHS 2002, due to local political turbulences and safety issues, several provinces were not surveyed, i.e. Aceh, Maluku and North Maluku, and Papua and West Papua. A total of 29,483 women aged 15-49 were interviewed in 2002/2003, 32,895 in 2007, 45,607 in 2012, and 49,627 in 2017. The dataset includes information on population-level need and RMCH service utilisation as well as some proxy measures of quality of care. The IDHS data collection methods, sampling and data management are described elsewhere (ICF 2018).

Measurement of effective coverage indicators using the coverage cascade

We assess levels of effective coverage in four key RMCH services: (1) family planning, (2) antenatal care, (3) maternal delivery service and (4) childhood immunisation. We used the adapted frameworks of Amouzou et al. (2019) and Marsh et al. (2020). In this framework,

effective coverage can be estimated using a six-step coverage cascade starting from target population to (1) service contact; (2) likelihood of services; (3) crude coverage; (4) quality-adjusted coverage; (5) user-adherence-adjusted coverage and; (6) outcome-adjusted coverage. The target population is everyone who is in need of a health service. Service contact is defined as the proportion of the target population who had contact with a health service. Likelihood of service is defined as the proportion of the target population who visit a health facility that is equipped to deliver the necessary services. Crude coverage is defined as the proportion of the target population who received the needed health service. Quality-adjusted coverage is defined as the proportion of those who received the health service according to the recommended intervention guidelines. User-adherence-adjusted coverage is the proportion of the target population who receive recommended care and also adhered to the intervention guidelines. And finally, outcome-adjusted coverage is the proportion of the target population experiencing the intended health gains from the health intervention. The measurement for each coverage cascade is conditional on the previous step.

Due to data constraints, in our current study we were only able to consider a subset of the previously described cascade of care. For three of the RMCH services (i.e. family planning, ANC, and childhood immunisation), we measured (1) service contact, (2) crude coverage, (3) quality-adjusted coverage, and (4) user-adherence-adjusted coverage. For maternal delivery care, we were only able to measure (1) service contact and (2) crude coverage. As an example, the target population for family planning services are reproductive age women who intend to space or limit pregnancy and service contact measures the proportion of the target population who had contact with the health service. Crude coverage counts those receiving service contact and using any modern contraceptive; quality-adjusted coverage counts those receiving crude coverage and also making an informed decision as quantified using the Method Information Index for family planning (MEASURE Evaluation 2017) and finally; user-adherence-adjusted coverage counts those receiving quality-adjusted coverage who also adhered to guidelines while using the chosen family planning method. A similar cascade was constructed for ANC and child immunisation service, from target population to user-adherence-adjusted coverage while maternal delivery only included target population, contact and crude coverage owing to absence of data to capture further elements of the cascade. The details of components of coverage indicators are presented in Table 1 and Appendix 4 and 5.

Independent variables

Individual covariates include the wealth index, constructed in the DHS using principal component analysis, as described in detail elsewhere (Rutstein & Johnson 2004). We categorised the wealth index into quintiles (Q1 (poorest) to Q5 (richest)). We also include regions of residency of the respondents to capture the levels of geographic inequality. The regions of residency were categorized following island groupings, i.e. Java-Bali, Sumatra, Kalimantan, Sulawesi and Eastern Indonesia. Java-Bali region is the most developed area in

Indonesia with higher population density, better health service provision and development level. Sumatra is the next best-off region of Indonesia, followed by Kalimantan and Sulawesi and the less developed Eastern part of the country that includes West and East Nusa Tenggara, Maluku and Papua.

Statistical approach

Coverage of services was estimated as a proportion of the target population who received the services along the effective coverage cascade with 95% confidence intervals (CIs). We applied survey weighting to estimate population-level effective coverage for each of the interventions. We first conducted a descriptive analysis across all survey waves and for all coverage indicators to identify the largest gap in coverage of services along the effective coverage cascade. Provinces were then grouped separately using the crude coverage of each type of RMCH service, i.e. family planning, ANC, maternal delivery and childhood immunisation. Groups were defined by the overall provincial coverage level of the respective indicator in the most recent survey; for family planning (low <40%; moderate 40-44%; high >45%), ANC and maternal delivery (low <80%; moderate 80-89%; high >90%) and childhood immunisation (low <60%; moderate 60-69%; high >70%) (see Appendix 18-21).

To assess the level and changes in socioeconomic inequalities in coverage, we calculated the concentration index for each of the service coverage indicators across all survey waves using the wealth status of the target population and constructed concentration curves to visualize the socioeconomic inequality in the indicators. The concentration index has been widely used to measure inequality in health and health care use and is calculated based on its relation to the concentration curve. The concentration index is described as twice the area between the concentration curve and the line of equality, or the 45-degree line. The concentration index is calculated as twice the covariance of the health variable and fractional rank in terms of the economic status, then divided by the mean of the variable, using the following formula (Kakwani, Wagstaff & Van Doorslaer 1997; Van Doorslaer et al. 1997):

$$CI = \frac{2}{\mu} cov(h, r)$$

where h is the health service coverage variable and r is the fractional rank in terms of socioeconomic status, and μ is the mean of the health variable. The value of the concentration index is negative if the curve lies above the line of equality. A negative value of a concentration index suggests that the distribution of the health variable, in this case RMCH service coverage, is skewed towards the poorer population. On the other hand, if the curve lies below the line of equality that would result in a positive concentration index value, the distribution of the health variable favours the richer population. The concentration index will take a value of zero if no inequality is observed.

As the RMCH indicators included in this study are binary, we applied the Erreygers normalisation that corrects issues in using the standard concentration index for binary variables as cited in previous literatures (Bonfrer et al. 2014; Erreygers 2009). The Erreygers normalised concentration index are calculated using the following formula (Erreygers 2009):

$$E(h) = \frac{4\mu}{(b_n - a_n)} C(h)$$

Where $C(h)$ is the standard concentration index, μ is the mean of the health variable and b_n and a_n are the upper and lower bounds of health service utilisation, respectively.

In order to assess within-country inequalities, we re-calculated the wealth index using the standard principal component analysis for each province separately. We then plot the concentration index within each province against the level of service coverage to see how inequality level corresponds to coverage in each province and to assess if pathways to UHC differ across RMCH interventions and provinces.

RESULTS

Using 2002-2017 IDHS survey, we included a total of 72,075 women aged 15-49 for the family planning indicators; 39,273 women who had had live births for ANC and maternal delivery service indicators and; 27,764 children aged 12-24 months for the childhood immunisation analyses. In 2002, there were 32 provinces in Indonesia and due to administrative separation of several provinces, there were 34 by 2017. Appendix 6 presents the socioeconomic characteristics of the sample population based on IDHS waves.

National estimates of levels and gaps along RMCH coverage cascades

Figure 1 presents the DHS 2017 national-level coverage indicators for four RMCH interventions based on the coverage cascade (see also Table 2). We found high levels of service contact of the four RMCH interventions; 56.4% (95% CI 55.4, 57.4) for family planning, 97.3% (95% CI 96.7, 97.7) for ANC, 92.2% (95% CI 91.1, 93.3) for maternal delivery care and 79.8% (95% CI 78.3, 81.1) for childhood immunisation. However, the quality-adjusted coverage decreased to 10.0% (95% CI 9.5, 10.6) for family planning, 25.6% (95% CI 24.1, 27.1) for ANC and 44.8% (95% CI 43.2, 46.4) for childhood immunisation, while crude coverage for maternal delivery service dropped to 81.5% (95% CI 79.9, 83.1). User-adherence-adjusted coverage levels were also very low for family planning (proxied using the adherence to the contraceptive guideline following informed decision in choosing a family planning method), ANC (indicated by consuming at least 90 tablets of iron supplement after receiving complete components of ANC) and childhood immunisation (proxied using timely DPT1-3 and measles vaccination) (9.67%, 16.64% and 7.70%, respectively). The gaps between each of the coverage indicators in all four interventions

indicate missed opportunities for achieving optimal health gains due to poor quality of services.

Trends in coverage and economic inequalities in RMCH effective coverage

All four RMCH coverage indicators have improved between 2002 and 2017, for all service cascades (Table 2) with annual increase in coverage levels ranged from 0.1% for ANC service contact to 12.4% for ANC user-adherence-adjusted coverage. Coverage for RMCH was higher for those in the more affluent groups compared with those in the poorer groups as the concentration index exceeded zero for all outcome measures ($p < 0.01$) in 2017 (Table 2, Appendix 7). The degree of inequality was larger for user-adherence-adjusted coverage, compared to service contact (Table 2, Appendix 8). For instance, while ANC service contact coverage was almost equally distributed across wealth quintiles (concentration index 0.02, 95% CI 0.01, 0.02), the index for user-adherence-adjusted coverage was more pro-rich at 0.219 (95% CI 0.19, 0.25).

Disparities between economic groups have reduced over time as seen from reduced concentration indices from 2002-2017 in almost all service coverage levels. For instance, the concentration index for delivery care crude coverage (i.e. institutional delivery) was 0.55 (95% CI 0.51, 0.59) in 2002 and reduced to 0.30 (95% CI 0.27, 0.33) in 2017. While we found similar trends for family planning and maternal delivery care, the concentration index for childhood immunisation user-adherence-adjusted coverage fluctuated; from 0.02 in 2002 and 2007, with an increase to 0.06 in 2012 and finally at 0.04 in 2017.

Levels and trends of geographical variation in RMCH effective coverage

We observed variations in the coverage levels across regions in Indonesia in almost all of the four outcomes in this study in 2017 (Figure 2). For instance, family planning service contact coverage in Java-Bali was 57.3% while it was only 48.9% in Eastern Indonesia. There were also wider disparities in the user-adherence-adjusted compared to the service contact coverage. This is particularly the case for ANC coverage, where contact service coverage was above 90% in all regions but user-adherence-adjusted coverage displayed wider variation; 22.6% in Java-Bali as opposed to only 5.3% in Sumatra.

Current gap between the rich and the poor based on provincial-level performance in RMCH service coverage

Figure 3 presents the service coverage along the RMCH care cascade by wealth quintile grouped by overall coverage rate for 34 provinces using the latest 2017 IDHS. The wealth quintile used for this analysis was recalculated at the provincial level. Provinces with low coverage had more pronounced socioeconomic inequalities with higher ratio between coverage for the richest and the poorest quintile (i.e. Q5:Q1). For instance, for ANC crude coverage, a woman in the poorest 20% from the low coverage group was two times less likely to receive at least four visits of ANC (ANC4+) than her counterpart in the wealthiest 20% (Q5:Q1 = 2.0). Unsurprisingly, disparities reduce as overall coverage increases.

However, even in provinces with moderate coverage, only 73.3% of women from the poorest quintile received ANC4+ compared to 94.7% of women in the richest quintile. Only when the overall coverage is high does the disparity become minimal (Q5:Q1 = 1.1). As we move along the care cascade, the overall coverage levels became very low for all provinces and inequality was less apparent.

Distributional pathways towards achieving UHC

Figure 4 plots the concentration index and the crude coverage of RMCH services for each of the Indonesian provinces from 2002-2017. We observed similar inequality patterns in relation to distribution of services between ANC and maternal delivery where more equitable distribution was achieved once overall coverage was high. Most provinces' concentration indices fell below 0.2 only after achieving at least 60% overall coverage. Maternal delivery care (skilled birth attendance) was the least equitable, with the highest concentration index recorded at 0.35 in 2017 for Maluku province. On the other hand, family planning and childhood immunisation services seemed to have relatively more equitable distribution even in provinces with low overall coverage level. For instance, the concentration indices for family planning crude coverage in 2017 ranged between -0.1 in Bali province (56.0% overall coverage) to 0.2 in Papua province (23.5% overall coverage). Similarly for childhood immunisation, even in provinces with very low coverage level (20-30%), the concentration indices was below 0.2. Our plotting of the concentration index and distribution of services for the other effective coverage cascades also show similar findings (see Appendix 22-25).

We also observed that provinces that had similar levels of overall coverage had very different equity levels. In order to visualise this, we plotted selected provinces that had similar levels of overall coverage for family planning and antenatal care (Figure 5). As an illustration, the overall family planning crude coverage for Papua and Maluku provinces in 2017 were at 23.5% and 23.7%, respectively. However, distribution of the service was more inequitable and pro-rich in Papua (concentration index = 0.22), while it was pro-poor in Maluku (concentration index = -0.04). The distribution of family planning quality-adjusted coverage in Papua was also more inequitable compared other provinces that had similar level of coverage. There seemed to be less variation in the level of inequality across provinces that had similar overall coverage level for antenatal care. And in general, inequality level reduces as provincial overall coverage level increases. However, taking Papua province as an illustration, at 52.2% overall coverage in 2007, its concentration index was 0.35. Maluku on the other hand, had slightly lower coverage at 50.4% in the same year but was more equitably distributed across the population (concentration index = 0.21). For the quality-adjusted coverage of ANC, few provinces also had more equitable distribution even at low overall coverage. For instance, Yogyakarta province's overall coverage in 2007 was at 18.4% (concentration index = 0.20) and had the highest overall coverage compared to other provinces in 2017 with concentration index close to zero (0.04).

Discussion

This is the first study using Indonesian datasets that analyses the current situation and trends over time the coverage of four RMCH services using the effective coverage framework and describes the inequalities in the coverage across provinces from 2002 to 2017. We found gradual improvement in all RMCH indicators over 2002-2017. While high levels of crude coverage were achieved across most RMCH interventions, quality-adjusted coverage was significantly lower (from 56.4% to 10.0%, 97.3% to 25.6%, and from 79.8% to 44.8% for family planning, ANC and childhood immunisation, respectively). Similarly, a substantial proportion of patients were 'lost' at the user-adherence stage (to only 9.7%, 16.6% and 7.7% for family planning, ANC and childhood immunisation, respectively). Maternal delivery service contact was at 92.2% and this dropped to 81.5% for crude coverage.

Despite economic and regional inequalities in coverage generally having reduced between 2000 and 2017, a large gap between economic groups and regions still persists. For example, the concentration index for user-adherence-adjusted coverage for ANC was at 0.219 and Sumatra region lagged behind at only 5.3% coverage compared to Java-Bali (22.6%). It is important to note that the levels of inequality were more pronounced for the indicators that are adjusted for quality or user-adherence, compared to crude coverage. This result suggests that estimates of socioeconomic inequalities using crude coverage might underestimate level of inequalities after considering quality of services.

We also observed different pathways towards high coverage levels where interventions that are delivered in health facilities, or require constant access to health service providers, tend to be more inequitably distributed across the population. This is particularly the case for antenatal care and maternal delivery services. On the other hand, family planning and childhood immunisation services tend to be more equitable even at lower level of overall coverage. Some provinces in Indonesia managed to increase the coverage level in a more equitable way, as seen from concentration indices that are close to zero even at low level overall coverage. However, provinces such as Papua had high level of inequity in access to RMCH services.

Our findings on the levels of inequity in relation to coverage level across different RMCH interventions echoed previous studies (Channon et al. 2013; Neal et al. 2015; Barros et al. 2012). In their multi-countries analysis, Barros et al. demonstrated that skilled birth attendant coverage was the least equitable RMCH intervention (Barros et al. 2012). The availability of health facilities and distribution within the population has been cited as the main factors affecting the equity in accessing RMCH service, particularly those that rely on access to secondary or tertiary level of care (Bhutta et al. 2010; Houweling, Ronsmans, et al. 2007; Atuoye et al. 2015). Interventions that are mainly delivered at community level, on the other hand, tend to be much more equitably distribution in the population. These include child vaccinations or oral rehydration therapy. Our results showing that family

planning was also more equitably distributed relates to the design of the program implementation in Indonesia. The Indonesia family planning program is also mainly used a community-based approach that is supported by a wide network of community health workers that assisted in the uptake of modern contraception (Frankenberg et al. 2009; Hull 2007; Shiffman 2007).

We observed that provinces with similar levels of overall coverage could have very different level of equity in access to RMCH services. It would be pertinent to systematically analyse the reasons and contributing factors for success in the more equitable provinces and to transfer their experiences to other provinces with larger inequities. It would be interesting to look at for example, how provinces that are similar in terms of health budget capacity and geographical challenges such as Maluku and Papua could have very different levels of inequity in almost all of the RMCH services. Local contexts, such as public sector efficiency, political commitment and the persistent local political turbulence and security issues –such as in the case of Papua– might play a role in the service delivery for maternal health services.

The overall increase between 2002 and 2017 in all RMCH coverage levels could be explained by various demand-side contextual and supply-side structural factors. Increase in health care seeking behaviour among women in Indonesia has been reported (Mahendradhata et al. 2017), which would also relate to increase in education levels and health literacy among women (National Population and Family Planning Board (BKKBN), Statistics Indonesia (BPS), Ministry of Health (Kemenkes) & ICF 2018; Aday & Andersen 1974). Indonesia has also implemented several financial protections programs aiming to improve healthcare utilisation, including RMCH services. A pro-poor health insurance system called Jamkesmas (Jaminan Kesehatan Masyarakat) was launched in 2004, resulting in increased use of health services among the poor population (Mulyanto, Kringos & Kunst 2019; Harimurti et al. 2013). In 2011, the Jampersal program provided cost-free reproductive, maternal and child health services for all women and children, regardless of their economic status (E. Achadi et al. 2014) And the more recent national health insurance program (Jaminan Kesehatan Nasional or JKN), launched in 2014, integrated all existing social health insurance and increased the coverage to a total of 133 million population by the end of 2019 (Agustina et al. 2018; Mboi 2015).

However, the constant gap between contact coverage and quality- or user-adherence-adjusted coverage suggest a much needed focus on the downstream cascade of service delivery (Kruk et al. 2018). The government needs to strengthen the health resources required to ensure the provision of timely quality care (Rajan et al. 2018; Gopalan et al. 2014; V. Gupta et al. 2018) by focusing resource allocation in the less-developed Indonesia regions. Resource allocation should also take into account contextual geographical factors such as population density and physical access to health providers. Furthermore, to address the socioeconomic inequality in the uptake of RMCH services, policies targeting the poor

and people living in limited-resource areas should be promoted. Measures to strengthen the linkages between home and health facilities are required, including the options to subsidise the referral costs for women from lower economic background or living in remote areas as well as utilising the services of community health workers (Titaley, Dibley & Roberts 2010; Ensor et al. 2008; Atuoye et al. 2015). Integrated care management that packaged interventions along the care cascades should also be strengthened, which was promoted during Jampersal era, but not in the current JKN program. Moreover, community and household contextual factors need to be identified and addressed through appropriate interventions. For example, trust in the skills of traditional birth attendants and cultural barriers between the community and modern health care providers have been documented to impede access and use of life-saving interventions (Bennett 2017; Vellakkal et al. 2017).

As the study shows which aspects along the cascade of RMCH services that need more attention, it provides an important debate, not just for Indonesia but at the global level. First is to promote the use of indicators that would effectively capture the quality aspect of RMCH services rather than crude coverage. However, there is still a reliance on population survey data including the DHS, where quality measures are difficult to ascertain based on user-reports. Thus, there is a need to have consistent reporting of health service quality measures across countries. As an example, the Quality of Care Network has initiated multi-countries partnership aiming to improve RMCH outcomes through multi-pronged approach, including establishing country-level health service report that includes the quality of care component (Quality of Care Network 2020). Such initiatives would allow countries to better address areas of improvement in quality aspect of RMCH care. Further, there is also a need to focus more on the continuum of care across the different stages of reproductive and maternal health services as well as early childhood interventions. This could be done, for instance, by constructing a variable that combines the information on services utilised during pre-conception, pregnancy and delivery as well as early neonatal periods.

The study has several limitations. First, while DHS collects a rich collection of RMCH data, there is a limitation in the availability of quality indicators. And while RMCH interventions have evolved substantially over the last three decades, most RMCH indicators in DHS have been collected in the same way since DHS conception in the mid-1980s (Munos, Stanton & Bryce 2017). Second, we also relied on self-reported information from household surveys, which is prone to recall bias. To minimize this, we limited our observation to the most recent birth from women who gave birth in the last 3-years prior to the survey for ANC and service delivery, and the family planning to a 6-months recall period. We also limit the childhood immunisation target population to only children between 12-24 months to minimise recall bias since immunisation data were derived from both the records on immunisation card but also mother's recall. The measurement of quality of care could be improved by combining self-reported information with facility-based data on service readiness as well as clinical competence of health staff in providing the services. Our results

might overestimate the EC without the assessment of the process of service delivery. Further, the indicators used for user-adherence adjusted might not be comparable across the different types of services. For instance, while ANC user-adherence adjusted variable takes into account longterm compliance in consuming iron supplementation, the indicators for child immunisation only takes into account the timeliness of the visit. Including a more complete continuum of child immunisation (up to 5 years old) might better capture the level of patient adherence. Finally, we gave equal weight to all clinical components of the services and did not account for differing clinical importance of the components as there is no prior literature on this. However, our approach was based on the WHO and national guidelines, which justify the inclusion of the components of care in this study.

Manuscript 2 Table 1. Components of coverage cascades and indicators for selected interventions along the RMNCH continuum

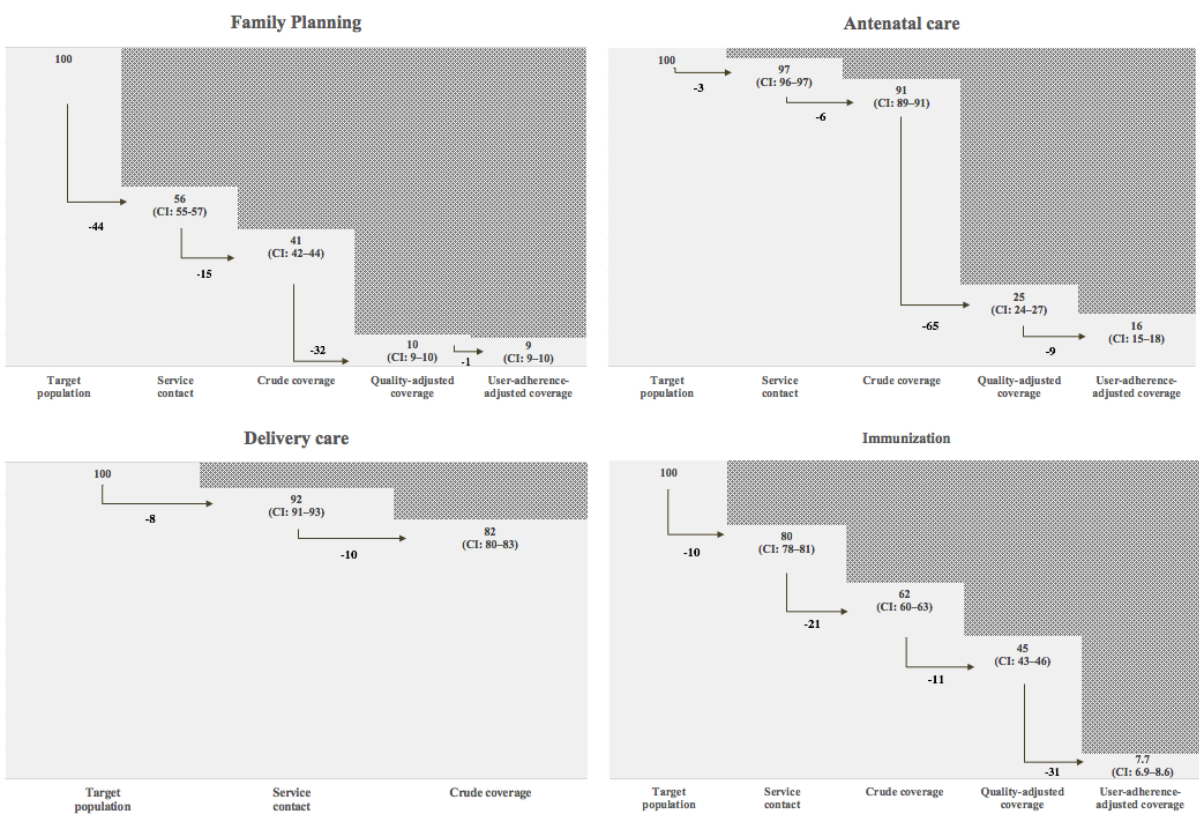
Intervention	Target Population	Service contact	Crude coverage	Quality-adjusted coverage	User-adherence adjusted coverage	Outcome-adjusted coverage
Family planning	Married or sexually active non-married women who were not currently pregnant and intended to space or limit pregnancy and have not undergone sterilization (including their male partner)	Women who had contact with health service either by visiting a health facility or were visited by a health worker in the last 6-months (for any reason)	Use any modern family planning method, except for sterilisation	Use any modern family planning method and had multiple choices of family planning and informed of side effects (scored for all of the Method Information Index ²)	Use modern family planning according to standards of use	Data not available
Antenatal visit	Women who had recently given live birth in the last 3 years of each of the survey wave	Use any number of ANC service	Use at least 4 times ANC service	Use at least 4 times and receive key components of ANC from health provider Components of ANC: - Weighed - Height measured - Blood pressure taken - Urine sample taken - Blood sample taken - Given/bought iron tablets/syrup	Received quality-adjusted ANC service AND adhered to consuming iron tablets for at least 90 days during pregnancy ³	Data not available
Delivery care	Women who had recently given live birth in the last 3 years of each of the survey wave	Skilled birth attendance. Type of skilled health professionals: - GP - OB-GYN - Nurse - Midwife - Village midwife	Skilled birth attendance at health facility Type of health facility: - Hospital - Clinic - Health post - Maternity home - OB-GYN clinic - Midwife/nurse clinic	Data not available	Data not available	Data not available
Immunization	Children aged 1-2 years old	DPT-1	DPT-1 thru DPT-3	DPT1-3 and measles ⁴	Received timely DPT1-3 and measles vaccination	N/A

² Method Information Index (MII) is one of the core quality indicators of Family Planning 2020 (FP2020). (See: FP2020. Track20. http://www.track20.org/pages/data_analysis/in_depth/opportunities/quality.php)

³ Iron supplementation during pregnancy is recommended to be taken for at least 90-days during pregnancy in countries with high prevalence of anaemia. (See: Ministry of Health Indonesia. Peraturan menteri kesehatan no. 97 tentang pelayanan kesehatan kehamilan. Jakarta, Indonesia: Ministry of Health 2014. <http://kesga.kemkes.go.id/images/pedoman/PMK%20No.%2097%20Ttg%20Pelayanan%20Kesehatan%20Kehamilan.pdf> and; World Health Organization. Iron with or without folic acid supplementation in women. WHO. 2016. http://www.who.int/elena/titles/full_recommendations/ifa_supplementation/en/)

⁴ According to Amouzou et al (2019), quality-adjusted coverage for childhood immunisation is defined as receives vaccination according to age and standards. For children aged 1-2 years, the main compulsory vaccinations that have been consistent from 2002-2017 are DPT1-3 and measles. And hence, these vaccinations were chosen as proxy for the variable.

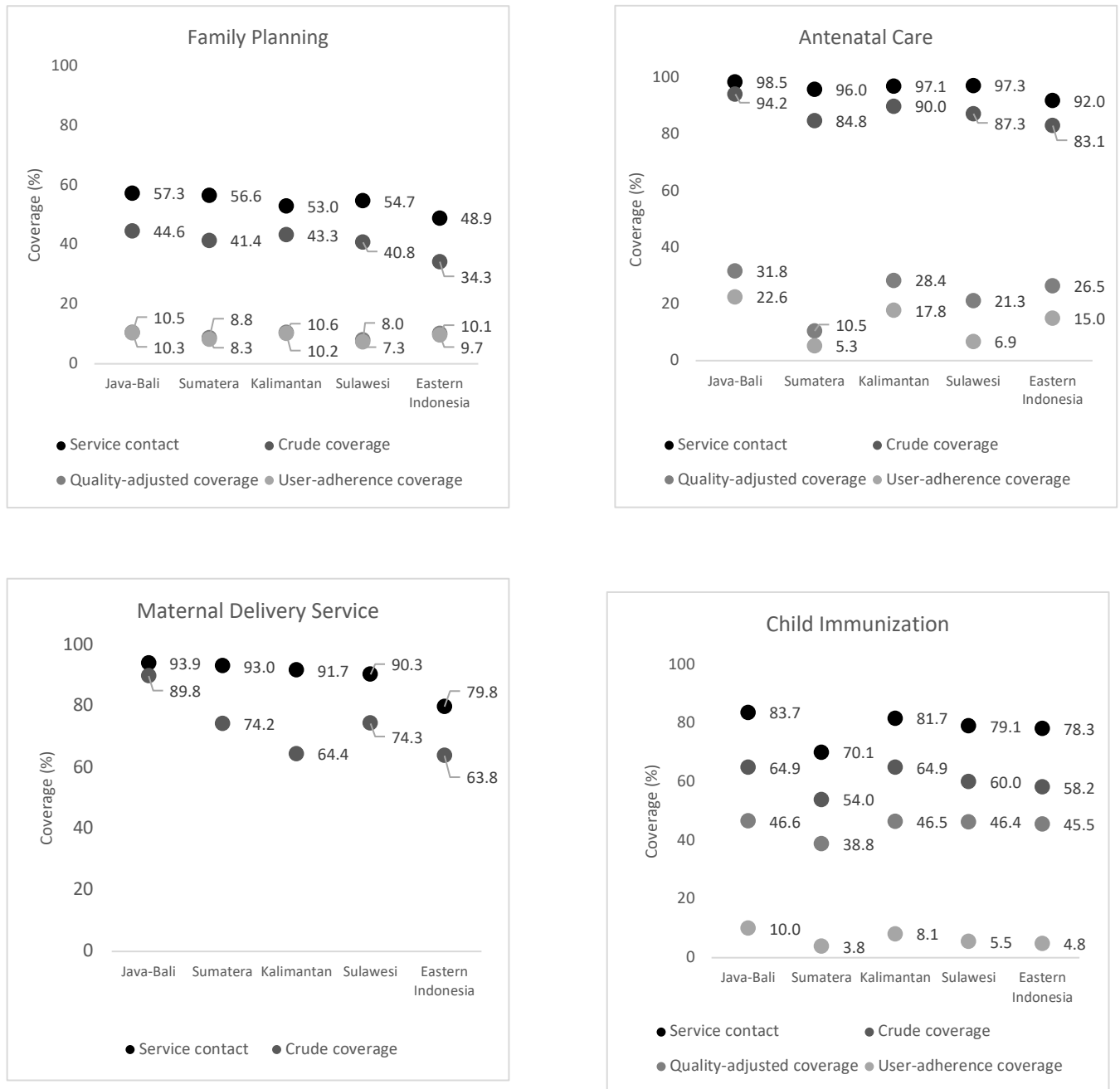
Manuscript 2 Figure 1. Cascade of care for RMCH services, 2017



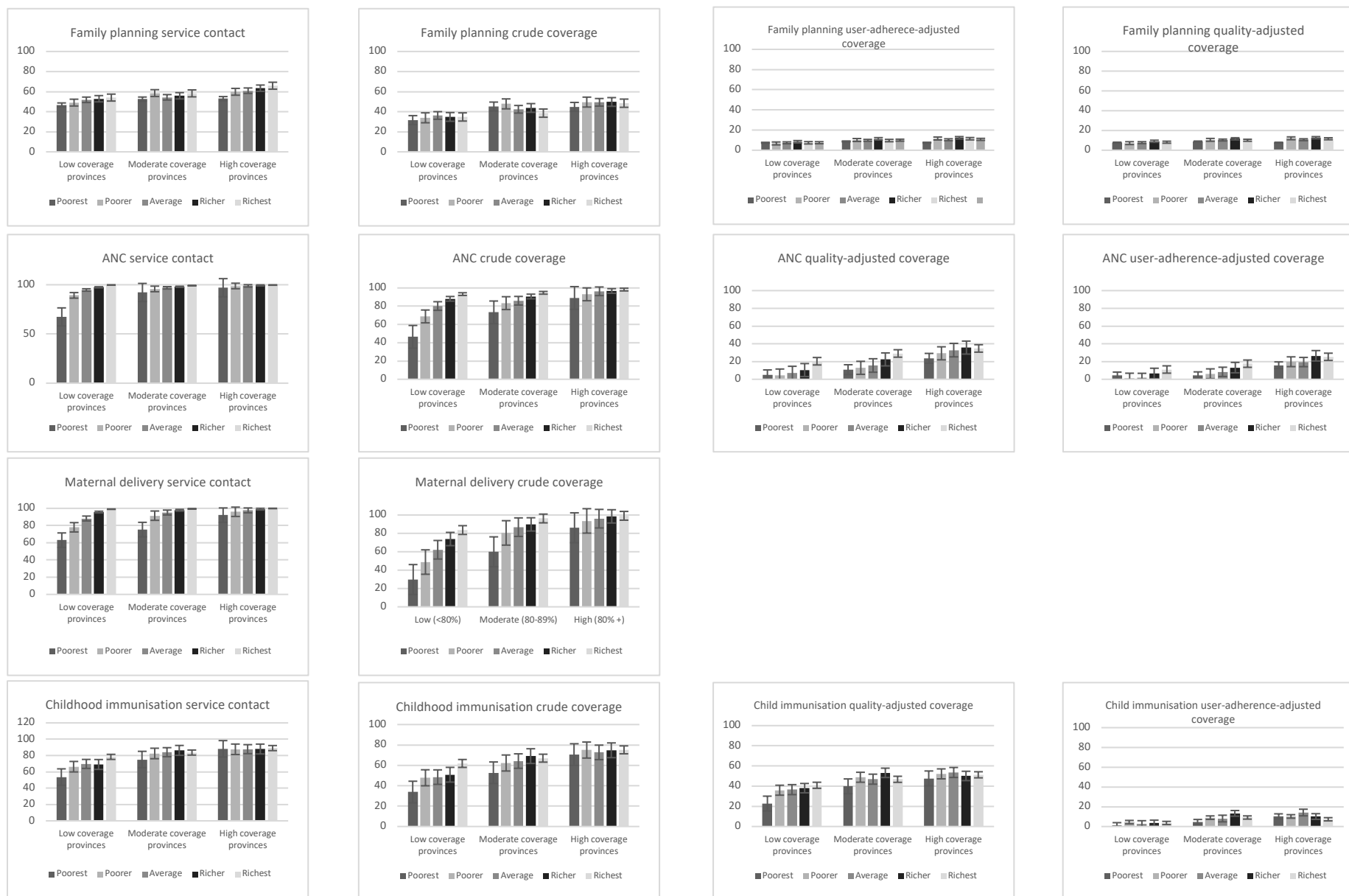
Manuscript 2 Table 2. Coverage levels and concentration indices for RMCH interventions in 2002, 2007, 2012 and 2017

RMCH Indicators	Coverage level and concentration index by survey year								% annual change in coverage level 2002-2017
	2002		2007		2012		2017		
	% (95% CI)	Conc. index	% (95% CI)	Conc. Index	% (95% CI)	Conc. Index	% (95% CI)	Conc. index	
Family planning services									
Service contact	37.7 (36.0, 39.4)	0.09	44.0 (42.4, 45.6)	0.13	55.2 (53.8, 56.5)	0.12	56.4 (55.4, 57.4)	0.08	2.9%
Crude coverage	30.3 (28.7, 31.9)	0.10	35.4 (33.9, 36.9)	0.12	44.1 (42.8, 45.4)	0.08	43.1 (42.2, 44.1)	0.03	2.7%
Quality-adjusted coverage	6.8 (6.2, 7.5)	0.04	8.3 (7.6, 9.0)	0.07	9.5 (8.8, 10.3)	0.06	10.0 (9.5, 10.6)	0.04	3.0%
User-adherence-adjusted coverage	6.1 (5.6, 6.8)	0.03	7.6 (6.9, 8.3)	0.08	9.2 (8.5, 9.9)	0.06	9.7 (9.1, 10.2)	0.04	3.6%
Antenatal care service									
Service contact	95.6 (94.7, 96.4)	0.08	95.8 (95.0, 96.4)	0.09	96.9 (96.4, 97.4)	0.07	97.3 (96.7, 97.7)	0.05	0.1%
Crude coverage	81.1 (78.7, 83.3)	0.25	81.7 (80.0, 83.2)	0.28	86.9 (84.9, 88.9)	0.21	90.5 (89.5, 91.3)	0.14	0.7%
Quality-adjusted coverage	9.9 (8.7, 11.4)	0.13	9.1 (8.2, 10.2)	0.09	15.1 (13.8, 16.5)	0.08	25.6 (24.1, 27.1)	0.15	9.8%
User-adherence-adjusted coverage	5.6 (4.8, 6.5)	0.09	5.2 (4.4, 6.0)	0.06	8.6(7.6, 9.6)	0.06	16.6 (15.4, 17.9)	0.13	12.4%
Delivery care									
Service contact	68.6 (65.6, 71.5)	0.43	75.3 (73.2, 77.3)	0.39	85.6 (84.0, 87.0)	0.28	92.2 (91.1, 93.3)	0.17	0.1%
Crude coverage	42.1 (39.0, 45.2)	0.55	49.2 (46.5, 51.9)	0.53	67.1 (64.9, 69.3)	0.44	81.5 (79.9, 83.1)	0.30	5.9%
Child immunization									
Service contact	65.8 (63.0, 68.5)	0.19	72.4 (70.3, 74.4)	0.22	80.6 (79.1, 82.1)	0.16	79.8 (78.3, 81.1)	0.10	1.3%
Crude coverage	39.9 (37.4, 42.6)	0.18	49.4 (47.2, 51.7)	0.23	60.2 (58.3, 62.1)	0.20	61.6 (59.8, 63.3)	0.14	3.4%
Quality-adjusted coverage	31.8 (29.6, 34.0)	0.13	37.2 (35.2, 39.3)	0.17	45.6 (43.6, 47.6)	0.16	44.8 (43.2, 46.4)	0.08	2.6%
User-adherence-adjusted coverage	2.8 (2.1, 3.7)	0.02	3.4 (2.6, 4.4)	0.02	7.2 (6.2, 8.3)	0.06	7.7 (6.9, 8.6)	0.04	10.9%

Manuscript 2 Figure 2. RMCH service coverage, by region 2017

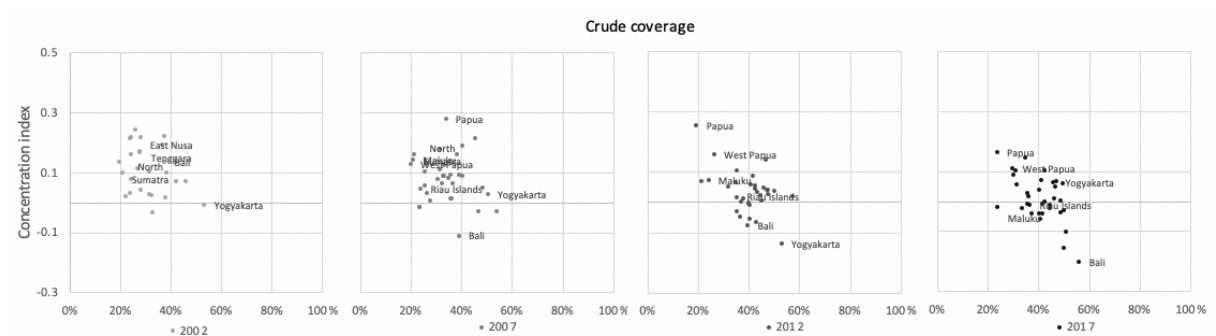


Manuscript 2 Figure 3. RMCH coverage by wealth quintile grouped by overall crude coverage rate for 34 provinces using 2017 DHS

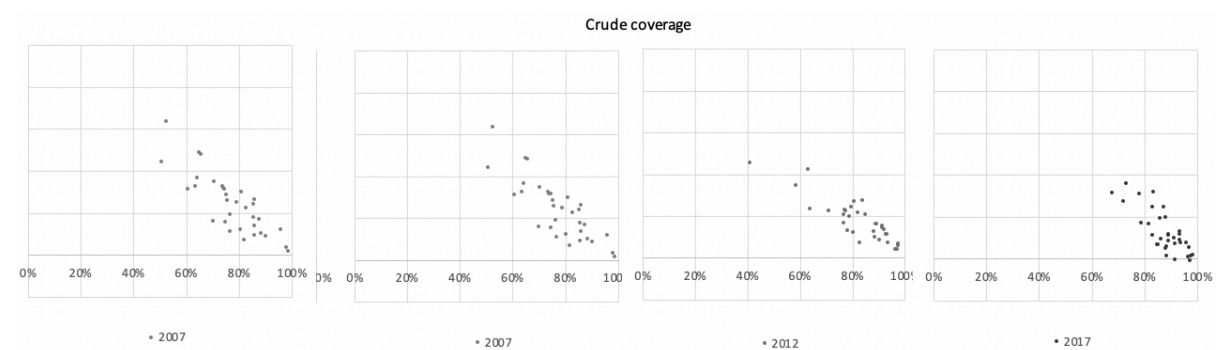


Manuscript 2 Figure 4. RMCH coverage and concentration index by province from 2002-2017 DHS

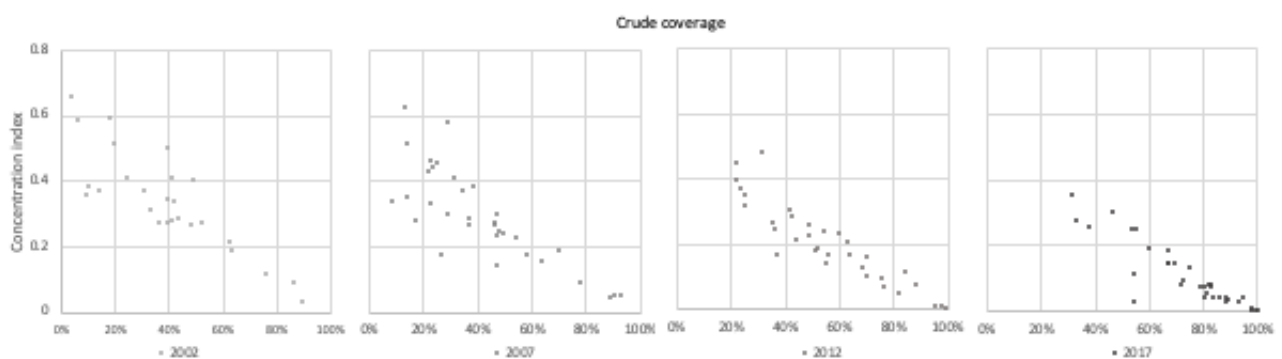
Family Planning



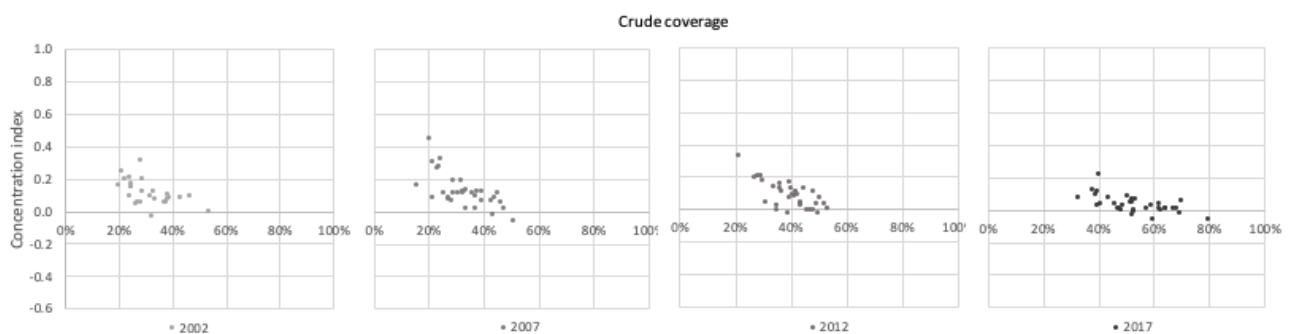
Antenatal Care



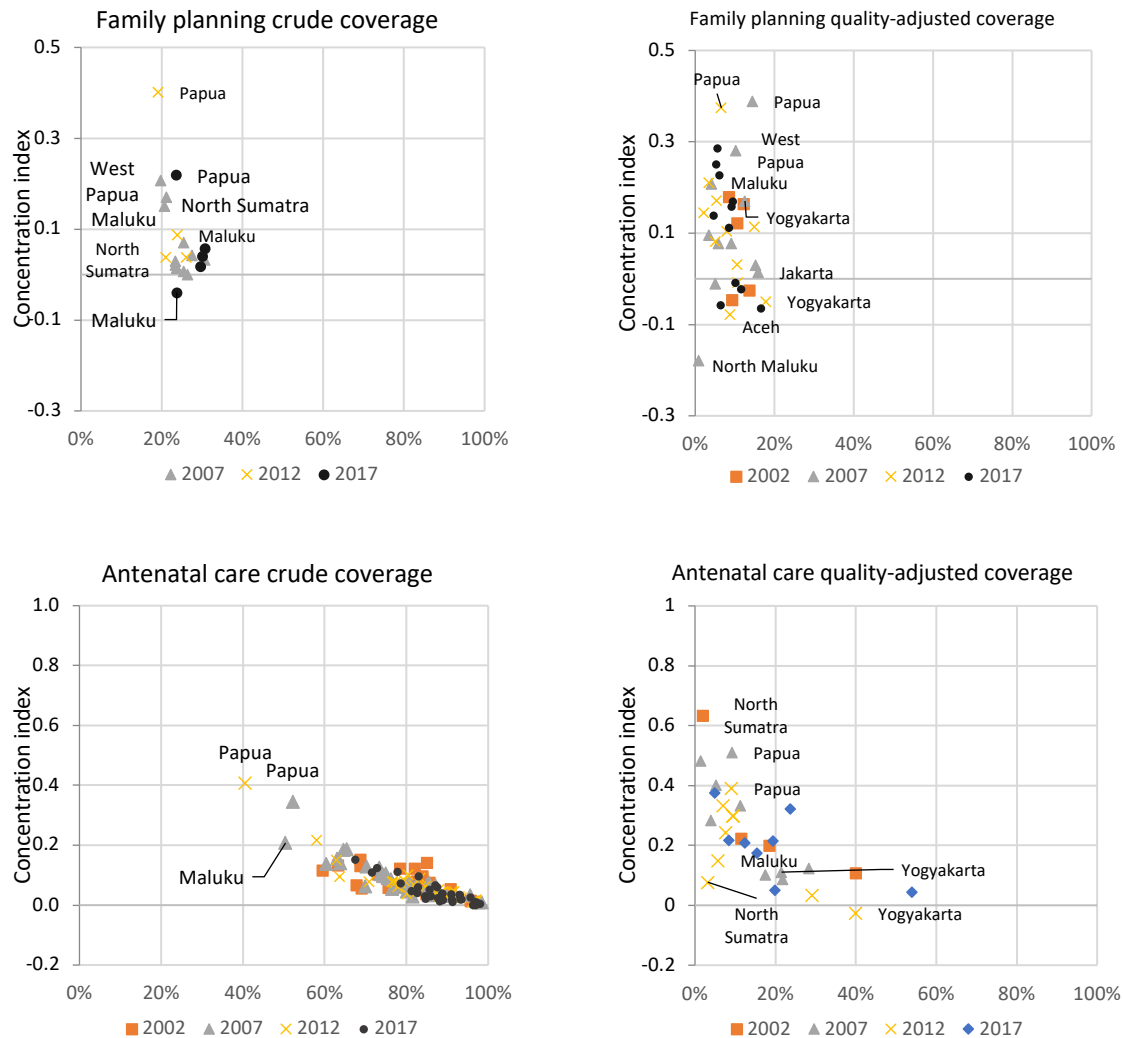
Maternal delivery care



Childhood immunisation



Manuscript 2 Figure 5. RMCH coverage and concentration index for selected provinces and indicators, 2002-2017 DHS



Chapter 8: The association of the Indonesia national health insurance program on maternal health service utilisation child mortality (Manuscript 3 & 4)

Preamble

The Indonesian government has made substantial investment in the health sector. The most recent national program on health is the introduction of the national health insurance program or the JKN. The JKN constitute of almost half of the national budget for health and is currently the largest single-payer insurance system in the world. In order to help improve the implementation of the program and its impact on population health outcomes, it is important to provide evidence on how JKN may have improved not only maternal and child health service use, but also the health outcomes. Furthermore, as the JKN program was designed as part of the effort to attain UHC, it is also important to assess how the JKN program has alleviate inequities in health.

This chapter consists of two manuscripts. The first manuscript assessed how the JKN program is associated with increase in the coverage of key maternal health services as well as reduction in neonatal and infant mortality. The second manuscript presents the effect of the JKN program on women's choice in the type of birth attendant and place of delivery, while considering important contextual factors of socioeconomic characteristics and region of residence. The recommendations provided in the second manuscript relate closely to the recommendations in Manuscript 1 on how primary health care should be strengthened in order to ensure equitable accesss to quality maternal and child health services.

Associations between national health insurance and maternal health service use, neonatal and infant mortality in Indonesia: an interrupted time-series analysis

Tiara Marthias, MD, MPH^{a, b}, Prof. Barbara McPake, BA, PhD^a, Natalie Carvalho, PhD^c, Prof. Christopher Millet, PhD^d, Kanya Anindya, MPH^a, Nurmala Selly Saputri, MPH^e, Prof. Laksono Trisnantoro, MD, PhD^b, John Tayu Lee, PhD^{a, d}

^aNossal Institute for Global Health, The University of Melbourne, Melbourne, Australia.

^bDepartment of Public Health, Faculty of Medicine, Public Health & Nursing, Gadjah Mada University, Indonesia.

^cCentre for Health Policy, School of Population and Global Health, The University of Melbourne, Australia.

^dDepartment of Primary Care and Public Health, School of Public Health, Imperial College London, United Kingdom

^eSMeRU Research Institute, Jakarta, Indonesia

ABSTRACT

Background

This study assessed the relationships between Indonesia's national health insurance program (*Jaminan Kesehatan Nasional [JKN]*) and maternal health services utilisation, and neonatal and infant mortality outcomes across population groups.

Methods

We utilized four waves of the nationally-representative Indonesia Demographic and Health Survey (DHS) from 2000–2017, which included 38,880 women aged 15–49 years and 144,000 birth records. Multilevel interrupted time-series (ITS) models were used to examine the associations between JKN, introduced in 2014, and changes in health service utilisation, neonatal, and infant mortality.

Findings

There were significant level increases in (1) at least four antenatal care visits (aOR 1.81 [95% CI 1.44–2.27]); (2) skilled birth attendance (aOR 1.83 [1.42–2.36]) and; (3) institutional delivery (aOR 1.45 [1.20–1.75]) following the introduction of JKN. Increases in antenatal care and institutional delivery utilisation were larger among the poorest compared with the most affluent. However, the effect of JKN on maternal service use were similar across geographical regions (p-value for interaction terms >0.05). No statistically significant associations were found between JKN introduction and neonatal and infant mortality (p-value >0.05) in the first three years following implementation.

Interpretation

The expansion of national health insurance led to substantial improvements in access to essential maternal health services in Indonesia and may reduce socioeconomic inequalities in access to health care. Our findings support WHO's call on accelerating expansion of social health insurance programs to achieve reduce socioeconomic inequalities in access to essential health care and attain key Sustainable Development Goals in low-and middle-income countries.

What is already known on this subject

Social health insurance coverage is associated with improved access to maternal and child healthcare. However, there is a paucity of evidence on the associations between universal health insurance coverage and its impact on reducing socioeconomic and regional inequalities, particularly in neonatal and infant mortality.

What this study adds

Using a robust time-series study design involving 38,880 women and 144,000 birth records from 2000-2017 in Indonesia, our findings indicate that Indonesia national health insurance program (JKN) was associated with improved uptake of at least four antenatal visits, skilled birth attendance and institutional delivery. However, there was no significant association between JKN and increase in caesarean section utilization. JKN was also associated with a larger improvement in four or more visits to antenatal care and institutional delivery for the lowest economic group compared with the most affluent group, however, these associations were similar across geographical regions. Our results did not suggest statistically significant associations between JKN and neonatal and infant mortality.

Policy implications

- Social health insurance may contribute to better access to key maternal health services, however, it may not be sufficient to reduce the geographical inequalities in maternal health care use.
- While improving coverage of health insurance is pertinent, policies to addressing barriers in access to and quality of care particularly in areas with limited health resources would be required to reduce neonatal and infant mortality.

INTRODUCTION

Reducing maternal and child mortality was one of the key targets of the Millennium Development Goals and now features among the Sustainable Development Goals (SDG target 3.1, 3.2) (United Nations 2016b). Despite significant global maternal and neonatal mortality reduction between 1990-2015 (United Nation 2015), socioeconomic and geographic inequalities persist in low-and middle income countries (LMICs), where the poor population and those living in rural areas have higher death rates (Houweling & Kunst 2010). These inequalities may partly be explained by factors including variations in provider quality, geographical distance, low health literacy, financial cost and other socioeconomic and cultural factors (Kruk & Prescott 2012; Agogbuo et al. 2011).

Improving access to maternal health services is a key policy component to achieve universal health coverage (UHC) and key SDGs in LMICs. Indonesia, the fourth largest country with one of the most diverse set of topologies and economic conditions, has the highest maternal and child mortality in the Southeast Asia region. At 177 maternal deaths per 100,000 livebirths in 2017, the ratio was significantly higher compared with neighbouring countries (for example, 29 in Malaysia and 121 in the Philippines). The infant mortality rate at 21 per 1,000 livebirths was also far beyond neighbours Malaysia (7) or Thailand (8). (World Health Organization 2019a) Further, there is a persistent inequity in maternal and child mortality across regions within Indonesia (Houweling et al. 2006). In the less-developed region of Papua, the maternal mortality ratio was double the national average at 380 per 100,000 live births (National Population and Family Planning Board (BKKBN), Health (Kemenkes), & ICF 2018).

The Indonesia government has invested substantially to improve access and reduce inequalities in maternal and child health services use and ultimately, to improve health outcomes. One of the major policies was the national health insurance program called *Jaminan Kesehatan Nasional* (JKN), introduced in 2014. JKN is the largest single-payer social health insurance programme in the world, aiming to achieve UHC by providing comprehensive care available to all. One of the JKN policy goals was to improve socioeconomic and geographical equality in health care access. (National Board of Social Insurance et al. 2012) At the start of the program, JKN covered 52.9% of the population and this coverage increased to 72.9% by the end of 2017, and 83% by the end of 2019, or nearly 225 million individuals (National Board of Social Insurance et al. 2012) (Figure 1 and Appendix 3). The programme covers basic and referral health services including those for expectant mothers as well as for children.

There are very limited studies evaluating Indonesia's JKN program, particularly in improving equity in maternal health services use and in reducing child mortality (see Panel 1). To fill this important evidence gap, we present the first national time-series study using data from 2000–2017 to examine (1) the associations between JKN and maternal health service use,

and neonatal and infant mortality and (2) differences between these associations across socioeconomic groups and geographical regions.

METHODS

Data and study sample

We used four rounds of the Indonesian Demographic Health Survey (IDHS) conducted in 2002/2003, 2007, 2012 and 2017. Detailed DHS objectives and methods can be found elsewhere (ICF 2018). In brief, DHS is the global standard for systematically monitoring and assessing the impact of key maternal and child policies. A multistage stratified design was used to generate a nationally representative sample of women ages 15–49 years, from all provinces in Indonesia. From the sampled households, 29,483 women aged 15–49 in 2002/2003, 32,895 in 2007, 45,607 in 2012, and 49,627 in 2017 were interviewed.

This study included women aged 15–49 years with a recent live birth. As information on maternal health service use was obtained only for births occurring in the last 3-years prior to each DHS wave, data were not available for 2003, third and fourth quarters of the years 2004, 2007, 2008 and 2012 as well as all quarters of 2013. To calculate neonatal and infant mortality, we linked IDHS data files for the birth and women recodes to construct complete birth records datasets. To attribute pregnancy record to either pre or post JKN period, we removed pregnancy records that spanned over both periods (i.e. pregnancy occurring between January – September 2014). We further removed observations with missing values in study variables (0.7% of the sample) (Appendix 1), resulting in 38,880 women and 144,000 births in our analysis for health service utilisation and mortality outcomes, respectively.

Variables

Our main outcomes were the use of maternal health services and child mortality. The four key maternal health services included; (1) at least four visits of antenatal care (ANC4+) with a skilled provider; (2) skilled birth attendance (SBA); (3) institutional delivery and; (4) caesarean section (CS). All variables were coded as binary variables with 0 for “no” and 1 for “yes”. We referred to the World Health Organization recommendation and the Indonesian medical services regulation and included doctors, midwives, auxiliary midwives and nurses in the category of skilled birth attendants (World Health Organization 2018). Institutional delivery was defined as a delivery occurring in a public or private health facility including hospital, health centre, clinic and maternity home. Two early childhood mortality outcomes included were; (1) neonatal death, defined as death of a child within the first month after a live birth and; (2) infant death, defined as child death before the age of 12 months.

We included the following sociodemographic characteristics as covariates: asset quintiles, maternal age at delivery, parity level, parental education, women’s occupation, type and

regions of residency (Java-Bali, Sumatera, Kalimantan, Sulawesi and Eastern Indonesia). The Java-Bali region is Indonesia's most developed area with higher density of population, health workforce and facilities. Sumatera is the next best-off region of Indonesia, followed by Kalimantan and Sulawesi and the less-developed area in the Eastern part includes West and East Nusa Tenggara, Maluku and Papua. The descriptions of the covariates are listed in Appendix 2.

DHS generates asset quintiles for each survey wave through principal component and factor analysis methods using information on types of housing materials and household properties ownership. Details on wealth index construction for the IDHS are described elsewhere (ICF 2018).

Statistical approach

Measures for neonatal and infant mortality

We estimated annual neonatal mortality rate (NMR) and infant mortality rate (IMR) using child birth histories obtained from respondents of women aged 15-49 years. We calculated the mortality-rate using data on child's date of birth, the survival status, the date of death and the age at death of deceased children. These methods are described in more detail in Appendix 6.

We used a multilevel interrupted time series (ITS) regression model to assess the impact of the JKN policy on maternal health services use and child mortality. While taking into account the underlying time trend, ITS model estimates the level and slope change in time trend after JKN policy implementation. This method has been widely used in evaluating health policies when random assignment of treatment or availability of a control group is not feasible (Bernal, Cummins & Gasparrini 2017; Jandoc et al. 2015).

We included a dummy variable coded as 0 for the period before and 1 after implementation of the JKN in January 2014 and a continuous variable set to 0 through January 2014, then equal to the number of calendar quarters (in the analysis of maternal health services use outcome) or years⁵ (in the analysis of neonatal and child mortality) since the JKN was implemented. We also included time variable throughout the study period to capture any long-term secular trend, calendar quarterly effect (Jan-Mar, Apr-June, July-Sep, Oct-Dec), and the socioeconomic covariates.

To account for the nature of our data (i.e. individual nested within province), our ITS model adopted a multilevel model specification as follows:

$$y_{it} = \beta_0 + \beta_1 time_{it} + \beta_2 policy_{it} + \beta_3 time_after_policy_{it} + \beta_4 X_{it} + v_i + e_{it}$$

Where y_{it} is the outcome at individual level; v_i is random intercept for provincial level, and is assumed to be independently distributed from the residual error e_{it} , β_1 is the estimate of

⁵ Due to relative rarity of child deaths, neonatal and infant mortality rates were estimated annually.

the quarterly/yearly average change in the outcome variables between 2000-2014, i.e. the underlying time trend. β_2 estimates the immediate (“level”) change in the outcome variables after JKN policy implementation (in year 2014) and β_3 estimates the gradual (“slope”) change in time trend in the outcome variables after JKN implementation (2014-2017). β_4 is the vector of estimates corresponding to the vector of individual covariates that include wealth quintiles, age group, marital status, parity, education level, type of mother’s occupation, type of residency, region dummy and calendar quarters dummy variable. We calculated the variance partitioning coefficient (VPC) for each level z to determine the variation in outcomes attributed to each level (Mohanty et al. 2018):

$$VPC = \sigma^2 v_0 / (\sigma^2 v_0 + \sigma^2 e_0)$$

We investigated whether socioeconomic status or geographic region modified the associations between the JKN, maternal health service use and mortality outcomes. Significant interactions between the JKN policy variables (e.g. dummy variable for the implementation of the JKN, and a continuous variable for the time after the implementation of the JKN) and population group were tested by fitting interaction terms between these variables. Our results were presented in the two models: (1) interaction with wealth quintile; (2) interaction with region.

We carried out three sets of sensitivity analyses as a robustness test. First, we tested the intervention effect estimated by comparing with a ‘false’ intervention initiation date of 2011, the last year for which complete birth data are available prior to the actual intervention initiation date (see Data and Study Sample section) (Bernal, Cummins & Gasparrini 2017; Stallings-Smith et al. 2013). If the effect of the ‘false’ policy timing was either non-significant or smaller in magnitude, it would imply that the actual JKN policy timing did have a true effect (Stallings-Smith et al. 2013).

Second, we conducted a before-and-after analysis by including a dummy variable for the period pre and post-JKN. In the pre-post analysis, we also controlled for existing time trend, sociodemographic characteristics and calendar quarterly effect. The model includes a dummy variable JKN coded as 1 for year after 2014, and 0 otherwise.

Finally, we tested whether our results were consistent in regression model with different numbers of data points prior to the implementation of the JKN. Therefore, we refitted the model with a shorter time span of 10 years prior to the implementation of the JKN (i.e. using data from 2005-2017 instead of 2000-2017 in our original model).

All analyses were conducted using Stata 14 SE.

RESULTS

We analysed 38,800 birth records for the assessment of maternal health service use and 144,000 birth records to calculate neonatal and infant mortality between 2000–2017. All data were nested in 33 provinces.

Between 2000 and 2017, use of all four maternal health services increased. ANC4+ use increased slightly (3%) while sizeable increases were observed for SBA, institutional delivery and CS use (27·83%, 67·63% and 308·17% increase, respectively) (Figure 2). Neonatal and infant health outcomes improved; NMR was reduced from 17·53 to 12·83 per 1,000 live births and IMR decreased, from 29·52 to 18·98 per 1,000 live births (Figure 3).

A descriptive summary of the 2017 DHS shows large socioeconomic and regional disparities in maternal health service utilisation, with higher coverage levels found in higher socioeconomic groups (Table 1). Among the richest subgroup, 97·42% (95% CI 96·47–98·12) had ANC4+ compared with 78·81% (95% CI 75·86–81·49) among the poorest population. Respondents with post-secondary education also had higher coverage for all services compared with those without any formal education, especially for CS (33·60% vs 2·82%, respectively). Geographical disparities were apparent between rural and urban residents. Further, for all maternal health services, less-developed regions such as Eastern Indonesia and Sulawesi had lower coverage levels compared with Java-Bali.

Socioeconomic and geographical inequalities in child mortality were also evident. There were higher proportions of child deaths among the poorest wealth quintile as well as in the less-developed regions. For instance, neonatal mortality was 1·94% (95% CI 1·47–2·57) within the poorest subgroup compared with 1·09% (95% CI 0·75–1·57) in the richest population. Infant mortality was 2·71% (95% CI 2·13–3·41) in Eastern Indonesia compared with 1·90% (95% CI 1·53–2·36) in Java-Bali.

Tables 2 and 3 present findings from the multilevel ITS model. Models A, B, C present findings from regression models without interaction terms (A), interactions between economic groups and policy variables (B), and interactions between regions and policy variables (C).

ANC4+: Our findings indicate a small increase in the underlying time trend at 1% quarterly (adjusted odds ratio (aOR) 1·01, 95% CI 1·00–1·01) between 2000–2014. We observed a large level change following JKN implementation (aOR 1·81, 95% CI 1·44–2·27) and a reduction in slope change in the time trend (aOR: 0·97, 95% CI 0·95–0·99).

SBA: There was a small increase in underlying time trend at 2% quarterly pre-JKN (aOR 1·02, 95% CI 1·02–1·02). Following JKN implementation, there was a large level increase (aOR: 1·83, 95% CI 1·42–2·36) but no significant changes in slope of the underlying time trend (p-value >0·05).

Institutional delivery: In pre-JKN period, there was an increase in underlying time trend at 3% quarterly (95% CI 1.03–1.03). There was a significant level increase following JKN implementation (aOR 1.45, 95% CI 1.20–1.75) and an increase in the slope of the time trend (aOR 1.02, 95% CI 1.0–1.04).

Caesarean section (CS): We found significant increase in underlying time trend at 3% quarterly (aOR 1.03, 95% CI=1.03–1.03). We did not find any association between JKN and level or slope change in CS use ($p>0.05$).

Neonatal mortality: There was no statistically significant time trend in neonatal mortality outcomes pre-JKN (aOR 1.00, 95% CI 0.99–1.01) and the JKN policy did not have any significant effect on level and slope change in neonatal mortality outcome ($p>0.05$).

Infant mortality: In pre-JKN period, infant mortality was reducing over time (aOR 0.98, 95% CI 0.97–0.99) but there was no significant level or slope change following JKN implementation.

We found individual level variables explained the largest share of variations in maternal health services utilisation, ranging from explaining 82.9% of the variation in institutional delivery to 98.6% of the variation in CS use (Appendix 8). Province-level variations explained 5.0% of the variation in ANC4 use, 8.3% for SBA, 17.1% for facility delivery and 1.4% for CS. For neonatal and infant mortality, province-level variations accounted for 0.7% and 1.0% of the variations, respectively.

To evaluate whether JKN has any effect in reducing socioeconomic and regional inequality, we conducted a series of two-way interaction term analyses (Table 2 and 3, Model B-C). Our results suggest that increases in ANC4+ and institutional deliveries were larger among the poorest compared with the most affluent (aOR 0.36, 95% CI 0.14–0.91; aOR 0.38, 95% CI 0.14–0.91, respectively). However, we did not find statistically significant differences in the associations between JKN and SBA and CS across economic groups. Additionally, the effect of JKN on maternal service use were similar across geographical regions (p -value for interaction terms >0.05).

Our sensitivity analysis using a ‘false’ time for JKN implementation showed that the hypothetical policy timing of 2011 had no statistically significant effect (p -value >0.05) on all maternal health services use (Appendix 16) as well as for child mortality (Appendix 17). These results suggest that our original estimates of the level and slope change were more likely associated with the JKN implementation. Our before-and-after specification shows associations between JKN policy and the change in coverage for ANC4+, SBA and institutional delivery (Appendix 18). We observed a negative effect of JKN on CS in this model specification (aOR 0.77, 95% CI 0.68–0.87). The before-and-after sensitivity analysis for neonatal and infant mortality revealed similar results with the original ITS model (Appendix 19). When we limited the time period of the observation to 2005–2017 (Appendix 20), we still obtained a similar result for ANC4+ and SBA. The odds ratio for JKN policy

institutional delivery was in the same direction as the original model, but was insignificant (aOR 1.18, 95% CI 0.97–1.43). Our sensitivity analyses with shorter time period also supports the original model for neonatal and infant mortality (Appendix 21).

DISCUSSION

This is the first national time-series analysis examining the associations between JKN and maternal health service use as well as child mortality. Between 2000-2017, we found significant level increase in ANC4+, SBA, institutional delivery and CS utilisation, reduced infant mortality but not for neonatal mortality. The JKN policy was associated with significant level increase in the overall maternal health service coverage, except for CS. The non-statistically significant associations between JKN and slope change in the underlying time trend may be due to ceiling effect of the outcome measures (Jandoc et al. 2015). The effects of JKN on ANC4+ and institutional delivery were more pronounced for the lowest economic group than the most affluent population, and the effects were similar across geographical regions. However, no major improvement in child mortality outcomes were found following JKN implementation.

The positive association between the expansion of the national health insurance program and increase in 3 out of the 4 maternal health care use is consistent with studies from both high-income countries and LMICs (Lagarde & Palmer 2008; Wang, Temsah & Mallick 2017; Carvalho & Rokicki 2019; Houweling et al. 2017). A systematic review also showed that removing user charges has led to immediate improved access to healthcare across settings (Lagarde & Palmer 2008). Our findings are also in line with a recent propensity-score matching analysis by Anindya et al. (2020) that showed JKN enrolment was associated with increased coverage of maternal health services including ANC, skilled birth attendance, facility delivery and postnatal care. (Anindya, Lee, McPake, Wilopo, Millett, et al. 2020) These findings highlight the importance of moving away from out-of-pocket spending or user fees to finance UHC, and toward prepayment schemes through taxation or insurance premium contributions that allow cross-subsidization from the wealthy to low-income groups (Fryatt & Bhuwanee 2017).

The findings in relation to the distributional effect of the policy are at odds with expectations. Indonesia has very high coverage of maternal health services amongst the most-developed region of Java-Bali (94.5% coverage for ANC4+, 89.9% for institutional delivery), such that ceiling effects significantly constrain further progress (Neal et al. 2015). Hence, it would be expected that increasing coverage would largely result from gains among less-developed regions with large equity gains, but this is not in fact observed. Compared with Java-Bali, the less developed region of Eastern Indonesia has not experienced the largest gain. It would be expected that gains would be concentrated in regions where pre-

JKN coverage rates had substantial scope for improvement whereas we find the effect of JKN on maternal service use appears to be similar across regions.

Our results showing no significant associations between JKN and CS utilization underscores challenges in access to higher-level maternity care. Emergency caesarean section as part of Comprehensive Emergency Obstetric Care, has been crucial in reducing the risk of neonatal deaths (United Nations 2016b; Kruk & Prescott 2012). The poorer population groups and less developed regions also have lower than the recommended 15% CS rate (Betran et al. 2015). However, unnecessary use of CS, particularly among the more affluent population, has been well documented (Gibbons et al. 2010) and thus, quality-oriented interventions should be aimed at appropriate rather than maximum use of this intervention. Policies should be geared towards improving equitable coverage of quality CS, including addressing maldistribution of health specialists (Mahendradhata et al. 2017) and facilities through affirmative policies such as surgical task shifting (Chu et al. 2009).

Our finding, that the implementation of JKN did not translate into improved child mortality, is consistent with a recent systematic review (Qin et al. 2019) showing that policies that remove user charges do not necessarily lead to improved health outcomes. However, given that neonatal outcome correlates with the quality of three of our coverage indicators, i.e. antenatal care, SBA and institutional delivery (Darmstadt et al. 2005), the significant increase in the coverage levels following JKN implementation is expected to translate into immediate improvement in neonatal outcomes. Our results may suggest that improvement in the quality of care has not accompanied JKN implementation, either due to limited supply-side reforms or disparities in the capacity of health facilities across Indonesian regions (Mahendradhata et al. 2017). The failure to achieve higher rates of coverage improvement in the poorest populations in the poorest regions also indicates the failure to reach those with the highest mortality rates and therefore to maximise the potential impact on mortality outcomes.

Achieving sustained and equitable improvement in maternal and child outcomes is a public health priority in Indonesia. Our findings suggest that health insurance coverage, standing alone, will not address the persistent socioeconomic and geographical inequalities in maternal and child health outcomes. This may require supply-side reforms (Gruber, Hendren & Townsend 2014) and stronger strategic purchasing functions of the JKN to ensure delivery of quality health services particularly in poorly resourced areas and among the poorest population (Trisnantoro et al. 2016). Considerations should also be given to addressing other barriers posed among the poorest population and those living in remote regions including transportation costs for referral services, that are not currently covered under JKN (National Board of Social Insurance et al. 2012). Increasing awareness about the benefit package of JKN through mass media campaign remains important, particularly targeting those with low education and income background who have limited information of JKN benefits (Agustina et al. 2018).

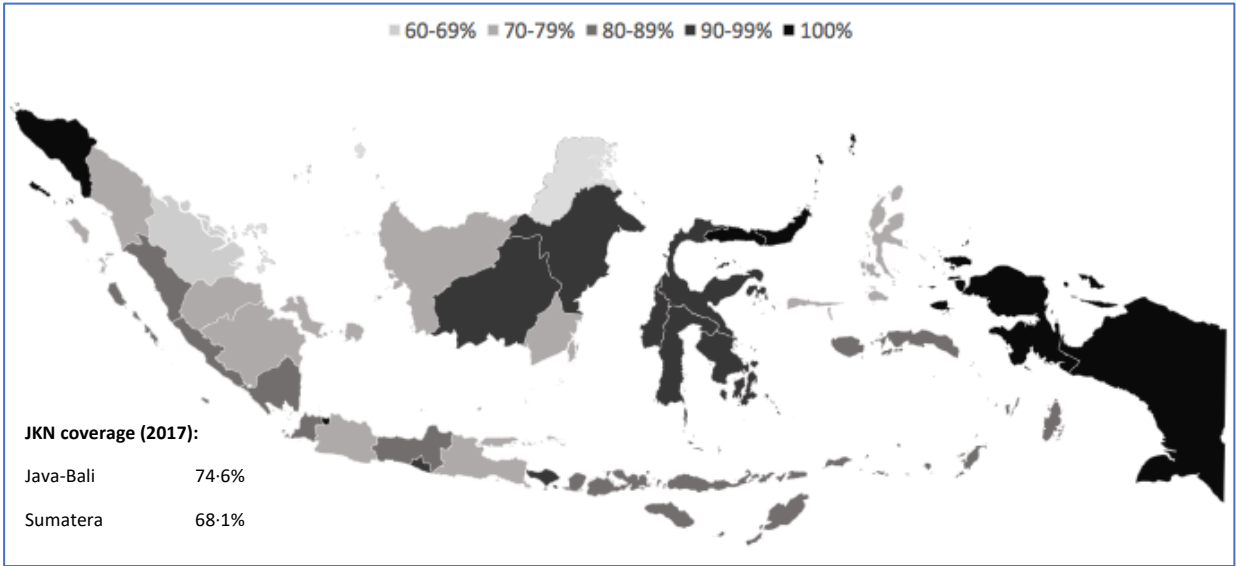
Strengths and limitations

There are several important caveats in our study. First, our results may have been affected by well-known measurement errors and potential recall bias associated with survey data. Second, in the absence of a control group, we cannot conclusively identify a causal relationship. There might be other policies that were introduced concurrently in 2014 that may interfere with the results. However, we are not aware of other national policies that would have the same effect on access to health service use. It is also important to note that we used data from the year 2017, and since then, there has been increase in the JKN coverage from 71.8% at the end of 2017 to 81.7% by the end of 2019. The strength of this study was the use of time-series analysis that accounted for secular time trends. Further, we performed several robustness checks that consistently support our original findings.

CONCLUSIONS

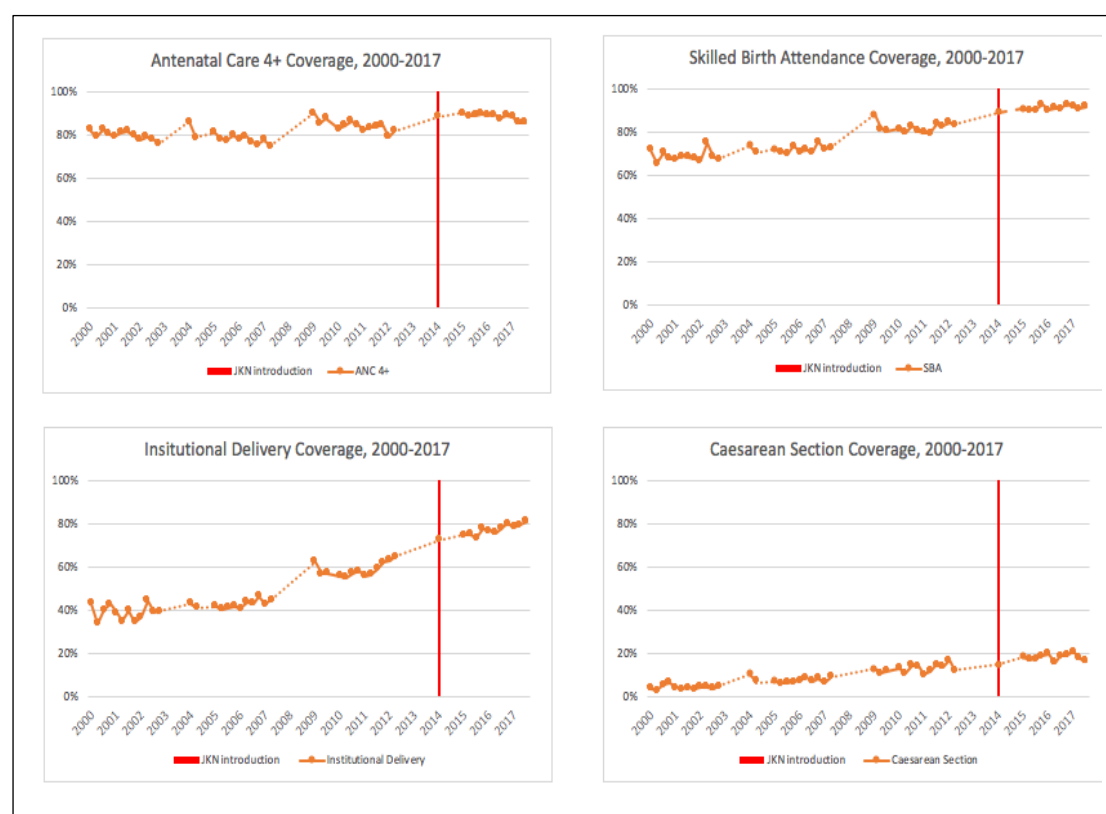
Expansion of social health insurance by was associated with improved access to maternal health services. Accelerating progress toward universal health coverage via expansion of social health programs can lead to reduced socioeconomic inequalities in access to health care in Indonesia. Improving neonatal and maternal mortality may require targeted prevention strategies for the poor, and supply-side interventions to improve access to quality of care.

Manuscript 3 Figure 1. Indonesia national health insurance coverage by province, 2019



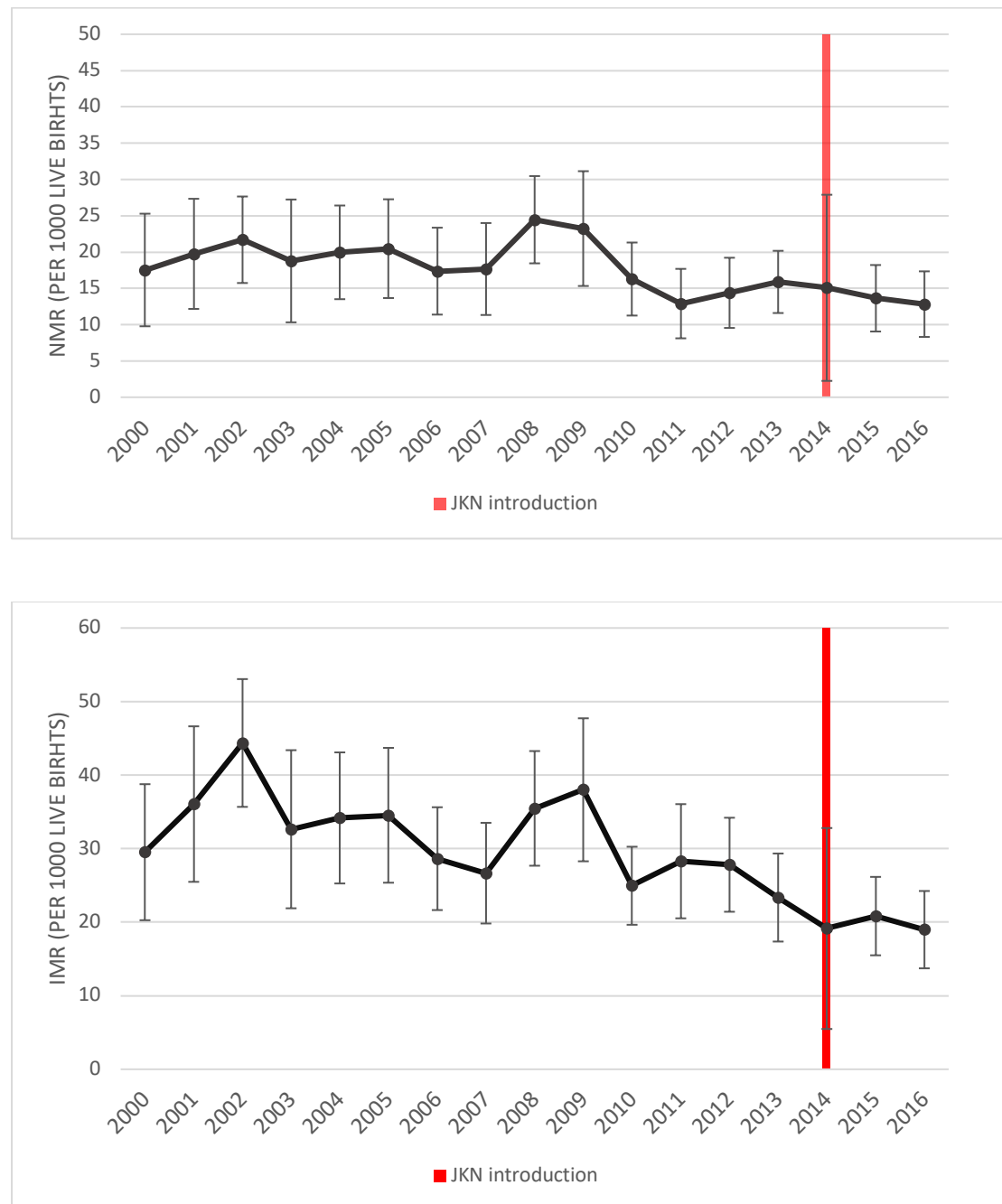
Source: BPJS-Kesehatan Indonesia (bpjs-kesehatan.go.id/bpjs/)

Manuscript 3 Figure 2. Unadjusted trends in maternal service utilisation coverage from 2000-2017



Note: As information on maternal health service utilization was obtained only for births occurring in the last 3 years prior to each DHS wave, data points were not available for 2003, third and four quarters of 2004, third and fourth quarter of 2007, 2008, third and fourth quarter of 2012, 2013. In addition, births records where the pregnancy and delivery overlapped with the pre and post-JKN period were exclude (second, third and fourth quarters of 2014).

Manuscript 3 Figure 3. Unadjusted trends in neonatal and infant mortality from 2000-2017



Manuscript 3 Table 1. Descriptive summary of maternal health service use and neonatal and infant mortality by socioeconomic and geographical sub-groups, DHS 2017

Variable	Antenatal Care 4+*		Skilled birth attendance*		Institutional delivery*		Caesarean section*		Neonatal mortality*		Infant mortality*	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Wealth quintile												
Poorest	78.81	(75.86, 81.49)	76.75	(73.46, 79.74)	55.76	(52.30, 59.17)	6.26	(5.22, 0.75)	1.94	(1.47, 2.57)	2.83	(2.28, 3.51)
Poor	89.15	(87.41, 90.67)	91.57	(89.44, 93.26)	78.87	(76.10, 81.40)	12.63	(10.97, 14.48)	1.19	(0.76, 1.84)	1.80	(1.29, 2.52)
Middle	93.06	(91.38, 94.44)	96.27	(94.92, 97.26)	86.83	(84.56, 88.81)	17.12	(15.15, 19.30)	0.85	(0.54, 1.34)	1.53	(1.08, 2.17)
Rich	95.54	(94.30, 96.53)	97.71	(96.53, 98.49)	90.94	(89.16, 92.45)	23.80	(21.38, 26.40)	1.89	(1.39, 2.58)	2.45	(1.83, 3.29)
Richest	97.42	(96.47, 98.12)	99.55	(99.04, 99.79)	96.92	(95.87, 97.71)	33.94	(31.09, 36.90)	1.09	(0.75, 1.57)	1.77	(1.30, 2.38)
Age at delivery												
15-25 years	90.07	(88.59, 91.37)	90.89	(89.11, 92.40)	79.23	(77.00, 81.29)	13.58	(12.11, 15.20)	1.33	(1.01, 1.75)	2.08	(1.64, 2.62)
26-35 years	91.67	(90.58, 92.64)	93.12	(91.88, 94.19)	82.58	(80.92, 84.12)	19.39	(17.96, 20.09)	1.21	(0.96, 1.53)	1.81	(1.50, 2.20)
36 – 42 years	88.62	(86.47, 90.47)	92.66	(90.69, 94.23)	83.67	(81.21, 85.87)	25.10	(22.54, 27.85)	2.15	(1.55, 2.96)	2.99	(2.26, 3.93)
42 – 49 years	91.93	(85.34, 95.71)	89.33	(81.82, 93.96)	81.00	(73.03, 87.03)	25.13	(17.96, 33.97)	2.15	(0.86, 5.26)	3.01	(1.41, 6.29)
Marital status												
Not married	78.91	(73.55, 83.44)	86.07	(81.71, 89.53)	72.74	(67.13, 77.71)	13.96	(10.05, 19.06)	1.61	(0.68, 3.73)	2.33	(1.21, 4.45)
Married	91.09	(90.20, 91.91)	92.48	(91.32, 93.49)	81.94	(80.44, 83.35)	18.65	(17.55, 19.80)	1.39	(1.19, 1.64)	2.08	(1.82, 2.38)
Parity												
1 child	85.99	(84.21, 87.60)	88.79	(86.84, 90.49)	75.48	(73.11, 77.70)	17.56	(15.88, 19.38)	2.20	(1.77, 2.72)	3.20	(2.67, 3.82)
2 or more children	92.90	(92.03, 93.69)	93.90	(92.79, 94.85)	84.53	(83.00, 85.94)	18.93	(17.69, 20.25)	0.98	(0.78, 1.24)	1.51	(1.25, 1.82)
Education												
None	50.65	(37.14, 64.06)	46.08	(32.98, 59.75)	33.32	(22.40, 63.38)	2.82	(0.95, 8.10)	3.66	(1.52, 8.56)	6.36	(3.67, 10.79)
Primary	84.69	(82.30, 68.81)	82.74	(79.93, 85.22)	67.37	(64.17, 70.42)	10.46	(9.01, 2.10)	1.75	(1.30, 2.35)	2.47	(1.95, 3.13)
Secondary	92.49	(91.61, 93.29)	95.36	(94.49, 96.09)	85.91	(84.50, 72.21)	17.94	(16.65, 19.31)	1.18	(0.95, 1.46)	1.73	(1.44, 2.08)
Post-secondary	95.85	(94.78, 96.71)	98.48	(97.59, 99.04)	90.89	(89.14, 92.38)	33.60	(30.87, 36.43)			2.47	(1.77, 3.42)
Women's occupation												
None	90.14	(88.90, 91.25)	91.97	(90.43, 93.27)	80.80	(78.82, 82.64)	17.02	(15.64, 18.48)	1.13	(0.88, 1.47)	1.59	(1.26, 1.99)
Agriculture	79.37	(85.12, 83.06)	78.43	(73.32, 82.78)	56.57	(51.21, 61.78)	7.68	(5.79, 10.12)	2.36	(1.53, 3.61)	3.65	(2.65, 5.00)
Blue-collar	92.37	(91.07, 93.49)	94.20	(92.83, 95.32)	86.50	(84.71, 88.11)	18.48	(16.69, 20.41)	1.39	(1.06, 1.81)	2.07	(1.65, 2.60)
White-collar	96.93	(95.85, 97.74)	98.36	(97.26, 99.02)	90.77	(88.60, 25.57)	32.70	(29.52, 36.05)	1.82	(1.23, 2.70)	3.06	(2.25, 4.14)
Residency												
Rural	87.70	(86.15, 89.10)	88.17	(86.17, 89.92)	71.51	(69.03, 73.86)	13.04	(11.73, 14.48)	1.37	(1.08, 1.72)	2.13	(1.78, 2.55)
Urban	93.89	(93.04, 94.64)	96.62	(95.64, 97.39)	92.42	(90.99, 93.63)	24.30	(22.65, 26.02)	1.44	(1.16, 1.78)	2.04	(1.69, 2.47)
Region of residency												
Java-Bali	94.50	(93.23, 95.55)	94.00	(92.24, 95.39)	89.97	(87.80, 91.79)	19.91	(18.25, 21.68)	1.28	(0.98, 1.66)	1.90	(1.53, 2.36)
Sumatera	85.09	(83.03, 86.94)	93.07	(90.65, 94.91)	74.45	(71.15, 77.49)	20.41	(18.46, 22.52)	1.49	(1.13, 1.97)	2.15	(1.69, 2.72)
Kalimantan	90.27	(87.77, 92.31)	91.75	(88.06, 94.38)	64.35	(58.00, 70.24)	12.58	(10.20, 15.42)	1.71	(1.10, 2.65)	2.30	(1.57, 3.36)
Sulawesi	87.56	(85.13, 89.64)	90.40	(87.69, 92.56)	74.44	(70.81, 77.77)	16.07	(13.71, 18.76)	1.71	(1.24, 2.35)	2.45	(1.88, 3.17)
Eastern Indonesia	83.35	(79.63, 86.65)	79.84	(75.76, 83.38)	64.00	(59.95, 67.86)	9.88	(08.15, 11.93)	1.45	(1.02, 2.05)	2.71	(2.13, 3.41)

*weighted proportions

Manuscript 3 Table 2. Multilevel logit regression of association between JKN and maternal health services utilization of a pooled sampled of the year 2000-2017

Variable	ANC 4+			Skilled birth attendance			Institutional delivery			Caesarean section		
	Model A: aOR (SE)	Model B: aOR (SE)	Model C: aOR (SE)	Model A: aOR (SE)	Model B: aOR (SE)	Model C: aOR (SE)	Model A: aOR (SE)	Model B: aOR (SE)	Model C: aOR (SE)	Model A: aOR (SE)	Model B: aOR (SE)	Model C: aOR (SE)
Time (year quarterly)	1.01 (0.00)	1.01 (0.00)	1.01 (0.00)	1.02 (0.00)	1.02 (0.00)	1.02 (0.00)	1.03 (0.04)	1.03 (0.00)	1.03 (0.00)	1.03 (0.00)	1.03 (0.00)	1.03 (0.00)
JKN policy	1.81 (0.21)	1.90 (0.31)	1.96 (0.55)	1.83 (0.24)	1.86 (0.30)	1.40 (0.39)	1.45 (0.14)	1.65 (0.24)	1.31 (0.29)	0.91 (0.09)	0.94 (0.26)	0.87 (0.14)
Time after policy (quarter)	0.97 (0.01)	0.98 (0.02)	0.96 (0.03)	1.00 (0.01)	0.99 (0.02)	1.05 (0.03)	1.02 (0.01)	1.02 (0.01)	1.06 (0.02)	0.98 (0.01)	0.98 (0.03)	0.98 (0.02)
Wealth x Policy Process interaction												
Quintile 2 x Policy Process		1.52 (0.44)			1.29 (0.41)			1.01 (0.23)			1.07 (0.37)	
Quintile 3 x Policy Process		0.53 (0.17)			0.80 (0.34)			0.68 (0.18)			0.85 (0.29)	
Quintile 4 x Policy Process		0.97 (0.39)			0.56 (0.32)			0.87 (0.26)			1.15 (0.39)	
Quintile 5 x Policy Process		0.36 (0.17)			0.22 (0.20)			0.38 (0.16)			0.88 (0.29)	
Wealth x Year-after-policy interaction												
Quintile 2 x Year-after-policy		0.95 (0.03)			0.98 (0.03)			1.00 (0.02)			1.00 (0.03)	
Quintile 3 x Year-after-policy		1.06 (0.03)			1.05 (0.05)			1.03 (0.03)			1.02 (0.03)	
Quintile 4 x Year-after-policy		0.97 (0.04)			1.08 (0.06)			0.97 (0.03)			0.97 (0.03)	
Quintile 5 x Year-after-policy		1.03 (0.05)			1.17 (0.12)			1.07 (0.05)			1.00 (0.03)	
Region x Policy Process interaction												
Sumatera x Policy Process			0.60 (0.20)			0.78 (0.30)			0.69 (0.19)			1.16 (0.27)
Kalimantan x Policy Process			0.74 (0.34)			1.00 (0.49)			0.81 (0.28)			1.39 (0.49)
Sulawesi x Policy Process			1.61 (0.63)			1.74 (0.71)			2.06 (0.64)			1.06 (0.32)
Eastern Indonesia x Policy Process			1.05 (0.37)			1.81 (0.63)			1.39 (0.40)			0.78 (0.25)
Region x Year-after-policy interaction												
Sumatera x Year-after-policy			1.02 (0.03)			0.97 (0.04)			1.00 (0.03)			1.00 (0.02)
Kalimantan x Year-after-policy			1.03 (0.05)			0.97 (0.05)			0.97 (0.03)			0.95 (0.03)
Sulawesi x Year-after-policy			0.99 (0.04)			0.96 (0.04)			0.96 (0.03)			1.02 (0.03)
Eastern Indonesia x Year-after-policy			1.01 (0.03)			0.92 (0.03)			0.92 (0.03)			1.00 (0.03)
Asset quintiles (Poorest as reference)												
Poor	1.60 (0.06)	1.64 (0.07)	1.60 (0.06)	1.90 (0.07)	1.88 (0.08)	1.90 (0.07)	1.69 (0.07)	1.70 (0.08)	1.69 (0.07)	1.73 (0.12)	1.72 (0.16)	1.72 (0.12)
Middle	2.02 (0.10)	2.06 (0.11)	2.03 (0.10)	3.01 (0.00)	2.95 (0.15)	3.03 (0.15)	2.25 (0.10)	2.32 (0.11)	2.25 (0.10)	1.99 (0.15)	1.99 (0.19)	1.97 (0.14)
Rich	3.01 (0.18)	3.21 (0.21)	3.02 (0.18)	5.31 (0.34)	5.25 (0.35)	5.34 (0.34)	3.35 (0.16)	3.64 (0.19)	3.36 (0.16)	2.71 (0.20)	2.85 (0.26)	2.69 (0.20)
Richest	5.34 (0.45)	6.27 (0.60)	5.35 (0.45)	11.74 (1.17)	11.78 (1.22)	11.87 (1.19)	6.19 (0.37)	6.58 (0.42)	6.25 (0.37)	3.68 (0.29)	3.91 (0.37)	3.64 (0.29)
Age at delivery (15-25 as reference)												
26-35 years	1.49 (0.06)	1.49 (0.06)	1.50 (0.06)	1.54 (0.06)	1.54 (0.06)	1.54 (0.06)	1.45 (0.05)	1.45 (0.05)	1.45 (0.05)	1.52 (0.07)	1.52 (0.07)	1.53 (0.07)
36 – 42 years	1.34 (0.07)	1.34 (0.07)	1.34 (0.07)	1.80 (0.10)	1.80 (0.10)	1.80 (0.10)	2.00 (0.10)	1.99 (0.10)	1.99 (0.10)	2.76 (0.18)	2.75 (0.18)	2.77 (0.18)
42 – 49 years	1.28 (0.15)	1.28 (0.15)	1.28 (0.15)	1.78 (0.23)	1.79 (0.23)	1.77 (0.23)	2.12 (0.26)	2.12 (0.26)	2.11 (0.26)	2.93 (0.45)	2.92 (0.45)	2.93 (0.45)
Marital status (not-married as reference)												

Married	1.90 (0.14)	1.92 (0.14)	1.91 (0.14)	1.23 (0.10)	1.23 (0.10)	1.22 (0.10)	1.06 (0.08)	1.06 (0.08)	1.03 (0.08)	1.02 (0.12)	1.02 (0.12)	1.01 (0.12)
Parity (1 child as reference)												
2 or more children	1.71 (0.07)	1.71 (0.07)	1.71 (0.07)	2.17 (0.07)	1.80 (0.07)	1.80 (0.07)	1.71 (0.06)	1.71 (0.06)	1.70 (0.06)	1.68 (0.08)	1.67 (0.08)	1.68 (0.08)
Education (none as reference)												
Primary	2.24 (0.15)	2.23 (0.15)	2.23 (0.15)	2.17 (0.16)	2.17 (0.16)	2.16 (0.16)	1.82 (0.17)	1.81 (0.17)	1.81 (0.17)	1.77 (0.40)	1.75 (0.40)	1.79 (0.41)
Secondary	3.85 (0.28)	3.83 (0.27)	3.84 (0.28)	4.78 (0.37)	4.78 (0.37)	4.77 (0.37)	3.32 (0.32)	3.30 (0.32)	3.30 (0.32)	2.46 (0.56)	2.43 (0.55)	2.50 (0.57)
Post-secondary	4.65 (0.51)	4.74 (0.52)	4.64 (0.51)	9.47 (1.27)	9.46 (1.27)	9.48 (1.28)	4.91 (0.55)	4.93 (0.56)	4.89 (0.55)	4.00 (0.93)	3.96 (0.92)	4.06 (0.95)
Women's occupation (none as reference)												
Agriculture	0.84 (0.03)	0.84 (0.03)	0.83 (0.03)	0.67 (0.03)	0.67 (0.03)	0.67 (0.03)	0.68 (0.03)	0.69 (0.03)	0.68 (0.03)	0.67 (0.06)	0.68 (0.06)	0.67 (0.06)
Blue-collar	1.18 (0.05)	1.18 (0.05)	1.17 (0.05)	1.08 (0.04)	1.08 (0.04)	1.08 (0.04)	1.05 (0.04)	1.06 (0.04)	1.05 (0.04)	0.96 (0.04)	0.97 (0.04)	0.96 (0.04)
White-collar	1.35 (0.13)	1.36 (0.13)	1.35 (0.13)	1.37 (0.15)	1.36 (0.15)	1.36 (0.15)	1.00 (0.06)	1.00 (0.06)	0.99 (0.06)	1.10 (0.06)	1.10 (0.06)	1.10 (0.06)
Residency (rural as reference)												
Urban	1.16 (0.04)	1.16 (0.04)	1.16 (0.04)	1.74 (0.07)	1.73 (0.07)	1.73 (0.07)	2.83 (0.09)	2.83 (0.09)	2.83 (0.09)	1.42 (0.06)	1.42 (0.06)	1.42 (0.06)
Region of residency (Java-Bali as reference)												
Sumatera	0.53 (0.11)	0.54 (0.11)	0.56 (0.12)	1.31 (0.36)	1.31 (0.36)	1.39 (0.39)	0.38 (0.15)	0.38 (0.15)	0.40 (0.16)	1.14 (0.13)	1.14 (0.13)	1.10 (0.14)
Kalimantan	0.59 (0.15)	0.59 (0.15)	0.59 (0.15)	0.78 (0.26)	0.77 (0.26)	0.81 (0.27)	0.20 (0.10)	0.20 (0.10)	0.23 (0.11)	0.82 (0.12)	0.82 (0.12)	0.88 (0.14)
Sulawesi	0.41 (0.10)	0.41 (0.10)	0.39 (0.09)	0.65 (0.20)	0.65 (0.20)	0.64 (0.20)	0.23 (0.11)	0.23 (0.11)	0.21 (0.10)	0.89 (0.12)	0.89 (0.12)	0.80 (0.12)
Eastern Indonesia	0.43 (0.10)	0.43 (0.10)	0.42 (0.10)	0.39 (0.12)	0.39 (0.12)	0.40 (0.12)	0.22 (0.10)	0.22 (0.10)	0.24 (0.11)	0.81 (0.11)	0.81 (0.11)	0.90 (0.13)
Months (dummy)												
January - March	0.97 (0.04)	0.97 (0.04)	0.97 (0.04)	1.03 (0.04)	1.03 (0.04)	1.03 (0.04)	0.98 (0.04)	0.98 (0.04)	0.98 (0.04)	1.02 (0.05)	1.02 (0.05)	1.02 (0.05)
April - June	0.98 (0.04)	0.98 (0.04)	0.98 (0.04)	1.03 (0.04)	1.03 (0.04)	1.02 (0.04)	1.00 (0.04)	1.00 (0.04)	1.00 (0.04)	0.91 (0.04)	0.91 (0.04)	0.91 (0.04)
July - September	1.04 (0.04)	1.04 (0.04)	1.04 (0.04)	1.02 (0.04)	1.02 (0.04)	1.01 (0.04)	1.02 (0.04)	1.01 (0.04)	1.02 (0.04)	1.00 (0.05)	1.00 (0.05)	1.00 (0.05)
October - December	(omitted)			(omitted)			(omitted)			(omitted)		
Random Parameters	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)
Level-2: Between-province variation	0.17 (0.04)	0.17 (0.04)	0.17 (0.04)	0.30 (0.08)	0.30 (0.08)	0.30 (0.08)	0.68 (0.17)	0.68 (0.17)	0.69 (0.17)	0.05 (0.01)	0.05 (0.01)	0.05 (0.01)

Note: In bold – significant at 5%.

Manuscript 3 Table 3. Multilevel logit regression of association between JKN and child mortality of a pooled sampled of the year 2000-2017

Variable	Neonatal mortality			Infant mortality		
	Model A: aOR (SE)	Model B: aOR (SE)	Model C: aOR (SE)	Model A: aOR (SE)	Model B: aOR (SE)	Model C: aOR (SE)
Time (year quarterly)	1.00 (0.01)	1.00 (0.01)	1.00 (0.01)	0.98 (0.00)	0.98 (0.01)	0.98 (0.00)
JKN policy	0.96 (0.27)	0.78 (0.37)	1.12 (0.66)	1.05 (0.24)	0.80 (0.37)	1.14 (0.55)
Time after policy (quarter)	0.99 (0.09)	1.03 (0.17)	0.85 (0.18)	0.97 (0.08)	1.01 (0.17)	0.89 (0.15)
Wealth x Policy Process interaction						
Quintile 2 x Policy Process		1.59 (1.30)			1.77 (1.30)	
Quintile 3 x Policy Process		1.50 (1.19)			1.51 (1.19)	
Quintile 4 x Policy Process		1.57 (1.21)			1.68 (1.21)	
Quintile 5 x Policy Process		0.93 (0.89)			1.35 (0.89)	
Wealth x Year-after-policy interaction						
Quintile 2 x Year-after-policy		0.78 (0.23)			0.81 (0.23)	
Quintile 3 x Year-after-policy		0.88 (0.24)			0.89 (0.24)	
Quintile 4 x Year-after-policy		1.03 (0.27)			1.02 (0.27)	
Quintile 5 x Year-after-policy		1.09 (0.35)			1.08 (0.35)	
Region x Policy Process interaction						
Sumatera x Policy Process			0.38 (0.31)			0.50 (0.34)
Kalimantan x Policy Process			5.89 (5.29)			3.53 (2.74)
Sulawesi x Policy Process			1.66 (1.41)			1.43 (0.99)
Eastern Indonesia x Policy Process			0.34 (0.30)			0.56 (0.38)
Region x Year-after-policy interaction						
Sumatera x Year-after-policy			1.57 (0.44)			1.35 (0.32)
Kalimantan x Year-after-policy			0.61 (0.21)			0.72 (0.21)
Sulawesi x Year-after-policy			0.93 (0.28)			0.95 (0.23)
Eastern Indonesia x Year-after-policy			1.58 (0.47)			1.26 (0.30)
Asset quintiles (Poorest as reference)						
Poor	0.84 (0.05)	0.85 (0.05)	0.84 (0.05)	0.78 (0.03)	0.78 (0.05)	0.78 (0.03)
Middle	0.87 (0.05)	0.86 (0.05)	0.87 (0.05)	0.74 (0.03)	0.74 (0.04)	0.74 (0.03)
Rich	0.78 (0.05)	0.75 (0.05)	0.78 (0.05)	0.66 (0.04)	0.64 (0.04)	0.66 (0.04)
Richest	0.63 (0.05)	0.63 (0.05)	0.63 (0.05)	0.53 (0.03)	0.52 (0.03)	0.53 (0.03)
Age at delivery (15-25 as reference)						
26-35 years	0.60 (0.03)	0.60 (0.03)	0.60 (0.03)	0.65 (0.02)	0.65 (0.02)	0.65 (0.02)
36 – 42 years	0.71 (0.05)	0.71 (0.05)	0.71 (0.05)	0.74 (0.04)	0.74 (0.04)	0.74 (0.04)
42 – 49 years	1.18 (0.20)	1.18 (0.20)	1.18 (0.20)	1.04 (0.15)	1.04 (0.15)	1.04 (0.15)
Marital status (not-married as reference)						
Married	0.83 (0.07)	0.82 (0.07)	0.83 (0.07)	0.80 (0.05)	0.80 (0.05)	0.80 (0.05)
Parity (1 child as reference)						
2 or more children	0.40 (0.02)	0.40 (0.02)	0.40 (0.02)	0.38 (0.01)	0.38 (0.01)	0.38 (0.01)
Education (none as reference)						
Primary	0.88 (0.07)	0.88 (0.07)	0.88 (0.07)	0.80 (0.05)	0.81 (0.05)	0.80 (0.05)
Secondary	0.79 (0.07)	0.80 (0.07)	0.79 (0.07)	0.68 (0.04)	0.68 (0.04)	0.68 (0.04)
Post-secondary	0.75 (0.09)	0.74 (0.09)	0.75 (0.09)	0.63 (0.06)	0.63 (0.06)	0.63 (0.06)
Women's occupation (none as reference)						
Agriculture	1.04 (0.05)	1.03 (0.05)	1.04 (0.05)	1.10 (0.04)	1.09 (0.04)	1.10 (0.04)
Blue-collar	1.03 (0.05)	1.03 (0.05)	1.03 (0.05)	1.03 (0.04)	1.03 (0.04)	1.03 (0.04)
White-collar	1.18 (0.11)	1.18 (0.11)	1.18 (0.11)	1.18 (0.09)	1.18 (0.09)	1.18 (0.09)
Residency (rural as reference)						
Urban	1.02 (0.05)	1.02 (0.05)	1.02 (0.05)	0.98 (0.04)	0.98 (0.04)	0.98 (0.04)
Region of residency (Java-Bali as reference)						
Sumatera	1.00 (0.10)	1.00 (0.10)	0.99 (0.10)	0.94 (0.08)	0.94 (0.08)	0.93 (0.08)
Kalimantan	0.99 (0.12)	0.99 (0.12)	0.96 (0.12)	0.93 (0.10)	0.93 (0.10)	0.91 (0.10)
Sulawesi	1.04 (0.11)	1.04 (0.11)	1.03 (0.11)	1.13 (0.11)	1.13 (0.11)	1.12 (0.11)
Eastern Indonesia	1.00 (0.11)	1.00 (0.11)	0.99 (0.11)	1.09 (0.10)	1.09 (0.10)	1.09 (0.10)
Months (dummy)						
January - March	1.15 (0.06)	1.15 (0.06)	1.15 (0.06)	1.14 (0.05)	1.14 (0.05)	1.14 (0.05)
April - June	1.10 (0.06)	1.10 (0.06)	1.10 (0.06)	1.12 (0.05)	1.12 (0.05)	1.12 (0.05)
July - September	1.07 (0.06)	1.07 (0.06)	1.07 (0.06)	1.14 (0.05)	1.14 (0.05)	1.14 (0.05)
October - December	(omitted)			(omitted)		
Random Parameters	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)	Est (s.e.)
Level-2: Between-province variation	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)

Note: In bold – significant at 5%.

The synergistic effect of insurance coverage, socioeconomic status and geographical region on women's choice in birth attendant and place of delivery in Indonesia: a multinomial logit analysis

Tiara Marthias, MD, MPH^{a, b}, Prof. Barbara McPake, BA, PhD^a, Likke Prawidya Putri, MD, MPH^b, Kanya Anindya, MPH^a, Diah Ayu Puspandari, PhD^b, John Tayu Lee, PhD^a

^aNossal Institute for Global Health, The University of Melbourne, Melbourne, Australia.

^bDepartment of Public Health, Faculty of Medicine, Public Health & Nursing, Gadjah Mada University, Indonesia.

^cCentre for Health Policy, School of Population and Global Health, The University of Melbourne, Australia.

Abstract

Background

Since 2014, the Indonesian government launched a national health insurance program (*Jaminan Kesehatan Nasional* or JKN) to provide health insurance coverage for all population and reduce patient cost sharing for health care, including maternal health services. Current available evidence suggests that deliveries were assisted by a diverse types of health providers and at varying levels of health facilities. We examined patterns of choice for childbirth and determinants that affect women's choices, with a focus on the health insurance coverage, geographical and the socioeconomic disparities.

Methods

Secondary analysis of Indonesian National Socioeconomic Survey (Susenas) 2018, consist of 41,460 women aged 15-49 years who had a recent live birth. Determinants of choice of place for delivery was assessed using multivariate multinomial logit regression model.

Results

JKN coverage was associated with significant increased use of higher level health provider and facilities and reduced the likelihood of choosing to deliver at primary health facilities or to be attended by midwife/nurse. Women who are enrolled in the JKN program were 13.1% more likely to be attended by OBGYN/GP and 17.0% more likely to deliver at hospital compared to uninsured women ($p < 0.05$). There was also a notable synergistic effect of insurance status, place of residence and economic status in women's choice of type of birth attendant and place of delivery. For example, women with health insurance coverage, living in Java-Bali and in the richest income quintile are 6.4 times more likely to be attended by OBGYN/GP and 4.2 times more likely to deliver at a hospital compared with those without health insurance, living in Eastern Indonesia, and in the poorest income quantile.

Conclusion

Our study reveals large variation in the choice of birth attendant and place of delivery by population groups in Indonesia. Evaluation of recent health system reform initiatives, such as the national health insurance program and the strengthening of primary health care, is essential to determine their impact on disparities in maternal health services and health inequities.

INTRODUCTION

Improving access to safe delivery is one of the components of health policy to avert maternal morbidity and death in many low-and middle-income countries (LMICs). Existing studies have shown that 16% to 33% of maternal deaths could be reduced through universal coverage of skilled birth attendance (Graham, Bell & Bullough 2001). The place of delivery is also linked to quality of maternal care. Home deliveries are less likely to have favourable outcomes compared with facility-based delivery due to higher rate of complications caused by poorer hygiene, limited access to skilled birth attendant (SBA), higher probability of infections as well as limited access to referral health facilities. Interventions that improve the coverage and uptake of high-quality maternal care is key to achieve Sustainable Development Goal (SDGs) target 3 that aims to reduce neonatal and maternal mortality to less than 12 per 1,000 livebirths and 70 per 100,000 livebirths by 2030, respectively (United Nations 2016b).

Indonesia, home of 270 million population, has the largest population and third highest maternal mortality ratio in the South East Asia region. Despite gradual improvement over the last decades, Indonesia maternal mortality ratio (MMR) at 177 per 100,000 in 2017 was higher than countries with similar levels of economic development level (World Bank 2020d). There are also large variations in maternal outcome across regions in Indonesia. For example, MMR in Java-Bali—the most developed areas in Indonesia—is substantially lower (147 per 100,000) compared to the other regions, in particular Sumatra, Kalimantan, and the Eastern islands (344, 466, 489, respectively, per 100,000) (Central Bureau of Statistics 2016). Such inequities may relate to the fact that rural areas and less developed regions have significantly lower health workers to population and limited health facilities, particularly ones that are equipped for safe deliveries and the management of delivery complications (Mahendradhata et al. 2017; Cameron, Contreras Suarez & Cornwell 2019; Kosen et al. 2014).

The Indonesian government has introduced a series of policies for primary care strengthening to improve outcomes and reduce health inequalities. As the primary health centres (PHCs) are available in all districts in Indonesia and are relatively more cost efficient than hospitals, the intention of such policy is to provide good quality health services and reach the majority of the population in the most efficient way. The same approach was also integrated into the Indonesia national health insurance program (*Jaminan Kesehatan Nasional* or JKN) that was implemented since 2014. The program aims to cover all population and increase access to quality health services including maternal and child health (Agustina et al. 2018; Mboi 2015). Under JKN regulation, all normal deliveries should take place at primary health facilities. Hospitals should only be utilised for referral cases of pregnancies and deliveries with complications or in areas where there is no available primary health facilities that are equipped to provide the services (Ministry of Health 2016). However, around 20% of delivery-associated JKN reimbursement at the hospital level was for normal deliveries (PKMK UGM 2019), which translates to around USD 42 million spent

for services that could actually be delivered at primary health care settings (Ministry of Health 2016). Anecdotal evidence indicated that this might be due to incorrect referrals and bypassing of the referral system due to lack of confidence by patients in the quality of care provided at primary health facilities (Syah 2019; Hadju & Nursyamsi 2020; Nugraheni, Mubasyiroh & Hartono 2020; Antina 2016; Radito 2014), particularly among the urban population and those from the wealthier economic background.

Few studies examined factors associated with skilled birth attendance and facility-based delivery (Erlangga, Ali & Bloor 2019; Anindya, Lee, McPake, Wilopo & Carvalho 2020; Nasution, Mahendradhata & Trisnantoro 2019), however, none of them have assessed the effect of JKN on the choice of different types of SBA and levels of health facilities and how the effect may vary across the socioeconomic groups and regions in Indonesia. Efendi et al. found that high wealth quintile, educational attainment and residing in urban predict childbirth in health facility (Efendi et al. 2019). Similarly, factors associated to SBA delivery were higher socioeconomic and educational status, living in urban and Java-Bali regions (compared to the Eastern region) (Nasution, Mahendradhata & Trisnantoro 2019). However, these studies have not examined the important heterogeneity in different choice of types of providers nor the levels of health facilities, such as delivery at home, primary care, hospital settings). Analysing data from 41,460 women, our study aims to assess the effect of health insurance, socioeconomic deprivation, and geographical region on women's choice of type of birth attendant and place of delivery across all provinces in Indonesia.

METHODS

Data

This study used the Indonesian National Socioeconomic Survey (Susenas) 2018, conducted by the Indonesia National Bureau of Statistics. Susenas is a nationally representative, multi-stage stratified survey that collects socioeconomic and health information. Importantly, Susenas includes a specific subsection that measures health care utilisation of women aged 15-49, including health care use during pregnancy and delivery. The original sample of the 2018 Susenas included 285,400 households and 1,098,260 individuals. This study focused on women aged between 15-49 years who had a delivery within 24 months prior to the survey. After excluding observations with missing values (1.6%), 41,460 most recent birth histories from women from 34 provinces of Indonesia were included in our analysis.

This study did not seek a full review from an institutional review board as this manuscript used secondary data analyses using dataset that is publicly available and contain no personal identifications of the survey participants.

Our main outcome variables are the choices of delivery made by women in their most recent delivery, this include (a) type of birth attendant who assisted during the delivery, (b) the choice of place of delivery.

For type of birth attendant, the alternatives were; (1) an OBGYN or a general practitioner (GP); (2) a midwife or a nurse or; (3) a traditional birth attendant (TBA) or other non-health birth attendant. Other non-health birth attendant could include a family member or no assistance at all. And the alternatives for choice of place of delivery were; (1) hospital (including secondary and tertiary hospital and either of private or public entity); (2) higher primary health facility (including public primary health centre or private delivery clinic); (3) lower primary health facility (including auxiliary primary health centre or a midwife clinic) and; (4) home or non-health facility delivery. The Susenas did not distinguish between public or private health facility.

Statistical approach

We used a multinomial logit model to estimate the probability of women's choice for delivery services. The model was based on a utility maximisation choice model which specify that the utility of choice j to individual i is U_{ij} :

$$U_{ij} = V_{ij} (INS_i, INC_i, REG_i, Z_i) + \varepsilon_{ij} \quad (1)$$

Where $V_{ij} (INS_i, INC_i, REG_i, Z_i)$ is the observed utility; INS is the women's insurance status; INC is the women's income level and; REG is the women's region of residence, Z is a vector of other individual characteristics such as age, education or occupation. ε is a vector of unobserved components. In this formula, j denotes the choice alternatives for:

Birth attendant:

$$j = \begin{cases} 1 & \text{OBGYN/GP} \\ 2 & \text{Midwife/nurse} \\ 3 & \text{Traditional birth attendant (TBA) or} \\ & \text{other non-health birth attendant} \end{cases}$$

And place of delivery:

$$j = \begin{cases} 1 & \text{Secondary-level health facility (hospital)} \\ 2 & \text{Higher primary-level health facility} \\ 3 & \text{Lower primary-level health facility} \\ 4 & \text{Home delivery} \end{cases}$$

The choices made by pregnant women depends on her characteristics and perceived benefits to maximise her utility from the delivery care. In other words, a pregnant woman chooses her delivery attendant (or place of delivery) given her insurance coverage status, income, education, her place of residence other features such as cultural preferences (Agus, Horiuchi & Iida 2018; Amaghionyeodiwe 2008; Yip, Wang & Liu 1998). It is important to note that this study do not attempt to capture the effect of women's autonomy in choosing and deciding where to deliver, but rather to assess how the status of women's insurance coverage may affect the utilisation of different types of birth attendants and place of delivery.

As the nature of the alternatives available in this study is multicategory and dissimilar from one another, we used the multinomial logit regression. This approach has been commonly used in health service research (Yip, Wang & Liu 1998; Amaghionyeodiwe 2008; Boachie 2015). The probability of a woman choosing an alternative j can be estimated using following equation:

$$Prob(Option_j|X_{ij}) = \frac{\exp(\beta_j X_{ij})}{\sum_{k=0}^3 \exp(\beta_j X_{ik})} \quad (5)$$

We presented results from multinomial logit using relative risk ratio (RRRs), controlling for all other covariates included in the analyses.

Independent variable

Our primary independent variables of interest are the enabling variables including women's insurance status, type and region of residency and economic status. Three main types of health insurance ownership in Indonesia are those covered by the government-organized national health insurance (*Jaminan Kesehatan Nasional* or JKN), private insurance providers or no insurance coverage. Women's economic status is measured by using the household's total expenditure per capita and converted into quintiles. The type of residency is denoted as urban or rural. We are also interested in assessing how the regions of residence affect the choices made by pregnant women in deciding who would assist with their deliveries and where to give birth. Java-Bali region –the most developed region– have much better access to higher quality of care, as opposed to other regions such as Sulawesi or Eastern Indonesia (Mahendradhata et al. 2017). There are also variations in the availability of supporting infrastructure due to differences in economic development, such as road quality and physical access, which may affect the choice of pregnant women.

Other independent variables include the sociodemographic characteristics; maternal age (less than 20 years, 20-25 years, 26-35 years and 35+), marital status (currently married or not), education level (no education, primary, secondary and post-secondary education) and occupation status (working or not working).

RESULTS

Descriptive analysis

Of the 41,460 women who recently gave birth, 29.2% chose to be assisted by OBGYN/GP, 59.9% by midwife/nurse and 10.8% chose TBA or other non-skilled attendant. The majority of women chose to deliver at a secondary facility (31.1%) followed with higher primary health facility (30.0%), home delivery (25.5%) and lower primary health facility (14.1%).

Sample characteristics are presented in *Table 1*. A large proportion of women were covered by JKN (63.3%), lived in Java-Bali region (52.6%), had secondary-level education (57.2%), were not working (66.9%), aged between 26-35 (51.5%) and were currently married (98.3%).

Factors associated with the choice of type of birth attendant

Table 2 presents the relative risk ratios (RRR) from the multinomial logit model for each alternative given a particular determinant or women's characteristics for the choice of birth attendant relative to TBA/non-skilled birth attendant. The results show increasing relative risk for choosing OBGYN/GP and midwife/nurse over a TBA as wealth status increases. The relative risks of choosing OBGYN/GP and midwife/nurse versus TBA were 12.3 and 3.3, respectively for women in the richest income quintile compared to the poorest. Having insurance coverage was also associated with statistically significant higher likelihood in utilising SBA over a TBA. Compared to those with no insurance coverage, women who were covered by the JKN were 2.9 (95% CI 2.5, 3.4) and 1.6 (95% CI 1.4, 1.8) more likely to choose OBGYN/GP and midwife/nurse, respectively, over TBA. Higher RRR for choosing OBGYN/GP (RRR= 6.50, 95% CI 3.1, 13.5) and midwife/nurse (RRR= 2.4, 95% CI 1.2, 4.9) over TBA, was observed for women with private health insurance compared to no insurance.

We present the predicted probabilities based on the multinomial logit regression in Table 3. Having health insurance increased the probability of choosing OBGYN/GP from 22.4% to 35.5% (for JKN) and to 45.3% (for private insurance). Those with any insurance coverage also have lower probability in choosing midwife/nurse or TBA compared to uninsured women. For instance, the probability for choosing TBA was 3.0% for JKN and 1.7% for private insurance, compared to 5.6% probability among uninsured women.

The likelihood of choosing OBGYN/GP over TBA was higher for women living in urban area relative to rural residents (RRR= 2.9, 95% CI 2.4, 3.7), while women living in regions outside of Java-Bali had lower likelihood to choose OBGYN. This is in line with the predicted probability (Table 3) showing lower probability for choosing OBGYN/GP for women living in regions outside Java-Bali. Probability of choosing TBA is also particularly higher for women in Eastern Indonesia (10.6%) compared to the other regions such as Java-Bali (2.8%), or Sumatra (3.4%).

The combined effect of insurance coverage, region of residence and wealth status on the choice of birth attendant is presented in Figure 1. The coverage of health insurance increased the probability of having an OBGYN/GP as the birth attendant and decrease the probability in using midwife/nurse or TBA. This implies that insurance coverage shifted the preference of type of birth attendant not only from TBA to skilled health provider but also from midwife/nurse to OBGYN/GP. Further, the synergistic effect of the insurance coverage, region of residency and economic deprivation was notably large. For example, women who were insured, living in Java-Bali region and from the richest income quintile had the highest probability of choosing OBGYN/GP (54.7%) compared to uninsured women who live in Eastern Indonesia and from the poorest income quintile (8.6%). In contrast, the lowest probability of choosing TBA was among insured women, living in Java-Bali and in the richest income quintile (1.5%) as opposed to their uninsured, poorest and living in Sulawesi region counterparts (2.3%). Interestingly, the insurance coverage had little effect in the choosing a TBA for women living in Eastern Indonesia.

It should be noted that region of residence play a significant role here. The probability of choosing an OBGYN/GP is higher for women living in Java-Bali region and were from the richest income quintile (54.7%) compared to women in the richest income quintile who were also insured, but live in Eastern Indonesia (36.5%). This implies that regions with less availability of health resources affect the benefit of having health insurance, regardless of the women's wealth status.

Factors associated with the choice of place of delivery

Table 4 presents the RRR for the multinomial logit regressions or the ratio of choosing an alternative relative to home delivery given a particular determinant or women's characteristics. Table 5 presents the predicted probability for type of place of delivery based on the explanatory variables.

Economic status was associated with choosing hospital and higher primary health facility over home delivery, with increasing likelihood as the women's economic status increases. There was no significant association between choosing lower primary health facility over home delivery and women's economic status.

The choice of place of delivery was associated with women's insurance status. Compared with no insurance, those with insurance coverage (either JKN or private), were more likely to choose hospital over home delivery (RRR 3.3 and 4.8, respectively) (Table 4). Those with any insurance coverage have lower probability in choosing home delivery (10.7% for JKN and 8.9% for private insurance) compared to 19.7% probability for women with no insurance coverage (Table 5). Similar with the choice of birth attendant, we observed that women with JKN and private insurance coverage had higher probabilities in choosing hospital delivery (38.3% and 45.8%, respectively) compared to only 21.3% for women without health insurance coverage. The variations in the predicted probability for choosing higher or lower primary health facilities were smaller across the women's characteristics.

The RRR for hospital delivery, higher and lower primary health facility over home delivery were 2.9, 2.9 and 1.7, respectively for women living in urban areas compared to rural counterparts. Compared to women living in Java-Bali, women in other regions were less likely to choose hospital delivery over TBA. Home delivery was also more likely for women living in Eastern Indonesia (21.9%) and Kalimantan (23.9%) compared to other regions such as Java-Bali (8.7%), Sumatra (18.0%) and Sulawesi (18.2%).

The synergistic effect of insurance status, region and economic status on the choice of place of delivery is shown in Figure 2. Across the regions, insurance coverage increased the likelihood of having hospital-based delivery and in general, decreased the likelihood of choosing primary health facilities as the place of delivery. As wealth status improves, the effect of having an insurance on choosing hospital-delivery also increased significantly. These imply that insurance coverage also shifted the preference on delivering at primary health facilities to higher-level facilities i.e. hospitals and that the richer population consistently had higher levels of hospital-based deliveries. As expected, the combination of

insurance coverage, wealth status and region, affect the choice of having home delivery. The lowest probability was observed among insured women from the richest income quintile who live in urban Java-Bali (2.3%) and the highest was among poor uninsured women living in Kalimantan (48.3%).

DISCUSSION

Main findings

Using data from 41,460 childbirth delivery from 34 provinces in Indonesia, we found substantial variations in choice for type of birth attendant and place of delivery by socioeconomic status, geographical region and health insurance status in Indonesia. Our results indicate that health insurance coverage (both JKN and private health insurance) was associated with increased use of higher level health provider and facilities and reduced the likelihood of choosing to be attended by midwife/nurse or to deliver at primary health facilities. Specifically, women who are enrolled in the health insurance scheme are more likely to be attended by an OBGYN/GP (increases from 22.4% to 35.5% for JKN and to 45.3% for private insurance), while the probability of visiting midwife/nurse decreases from 72.0% to 61.5% (JKN) and to 53.0% (private insurance). Health insurance coverage also increases the probability of having a hospital delivery, from 21.3% to 38.3% (JKN) and to 45.8% (private insurance). Conversely, having an insurance coverage also decreases the probability of delivering at a higher primary health facilities, from 38.2% to 35.8% (JKN) and 31.5% (private insurance).

Our results also indicate that high-level healthcare utilisation was mainly enjoyed by women living in Java-Bali and from the richest income quintile. Living in urban areas or Java-Bali increased the probability of being attended by an OBGYN/GP during delivery and to deliver at a hospital compared to other regions of Indonesia. Furthermore, compared to the poorest income quintile, being from the richest income quintile increases the probability of having attended by OBGYN/GP from 22.0% to 52.5%. Women from the richest income quintile had 51.5% probability of having hospital-based delivery, compared to only 23.2% among women from the poorest income quintile.

As a whole, we also found notable synergistic effect of insurance status, place of residence and economic status in women's choice of type of birth attendant and place of delivery. Women with health insurance coverage, living in Java-Bali and in the richest income quintile have the highest probability in being attended by OBGYN/GP during delivery and to deliver at a hospital. Conversely, women who are in the poorest income quintile and had no health insurance and living in Eastern Indonesia had the highest probability of being attended by a non-skilled provider. Home delivery was most likely for women living in Kalimantan, not insured and from the poorest income quintile.

Comparison with literature

Our results confirm the findings of previous studies about the impact of the health insurance policies on the choice of birth attendance and place of delivery in Indonesia and other LMICs (Agus, Horiuchi & Iida 2018; Ravit et al. 2020; Barros et al. 2005; Brooks et al. 2017; Nyongesa et al. 2018). A descriptive study exploring women's choice of maternal healthcare in Parung, West Java, Indonesia, found that insured women had a higher likelihood of receiving delivery care from a midwife compared to TBA (Agus, Horiuchi & Iida 2018).

Our results showing variations in the choice of birth attendant and place of delivery across socioeconomic groups and geographical regions support the notion that socioeconomic deprivation manifest as inequality in accessing high-quality maternal health services. More deprived groups tend to deliver at home or at lower primary health facility with less-competent providers (Nyongesa et al. 2018), which potentially lead to poorer health outcomes. According to a recent report by the World Bank, the ability of public primary health centres in providing basic emergency obstetric and neonatal care services is very low (Rajan et al. 2018). For instance, only 48% of the sampled health centres offered the removal of retained products, meaning that if postpartum haemorrhage was caused by retained placental fragments, half of these facilities would not be able to handle the complication. Furthermore, the survey also found urban-rural variations in the capacity of the primary health centres in managing maternal delivery services.

Previous studies in Indonesia suggest that health insurance coverage expansion alone is not sufficient to encourage the utilisation of quality skilled birth attendance, particularly for people residing in rural areas (Widayanti et al. 2020; Erlyana, Damrongplasit & Melnick 2011; Nasir et al. 2016). Indirect costs of treatment, such as travel cost and long travel time to health facilities, posed additional burdens to not only patients but also their families (Erlyana, Damrongplasit & Melnick 2011; Nasir et al. 2016). Erlyana et al., using the third waves Indonesia Family Life Survey, found that rural uninsured groups were more sensitive to out-of-pocket costs related to commuting distance than medical cost (Erlyana, Damrongplasit & Melnick 2011). A qualitative study in rural India also reveals that the introduction of the JSY program was ineffective to motivate women for institutional delivery due to the distance to the health facility, which incurred additional transportation cost and attendant charges (Erlyana, Damrongplasit & Melnick 2011; Bose 2019). Moreover, the complex administration of health insurance and the lack of knowledge of how to utilise it in an emergency, were also identified factors that hinder women from utilising health services (D'Ambruoso 2012).

Policy implications

Since the early 1990s, Indonesian policies have been focused on increasing delivery attended by any skilled attendant or delivery in health facilities. Resources have been allocated for meeting these targets: establishing village midwife, village birthing posts, equipping auxiliary public health care facilities (*Puskesmas*) with delivery apparatus, upgrading Puskesmas with Basic Emergency Obstetric Care (BEmOC) facilities and building

maternity waiting homes next to the Puskesmas to improve physical access to facility delivery (Kaslam 2014; Indonesia National Bureau of Planning and Development, Government of Central Java & United Nations Indonesia 2013; Shankar et al. 2008). However, as the latest evidence shows positive associations between lower MMR and higher number of doctors and shortest distance to hospitals but not with the number of midwives or distance to primary health centres (Cameron, Contreras Suarez & Cornwell 2019), implying the lower quality offered at the primary health care setting. The low confidence level among patients in the quality of primary health facilities has also resulted in bypassing of the referral system and higher use of hospital services (Antina 2016; Radito 2014), particularly among the richer population and those living in urban areas. Therefore, there is a need to monitor quality indicators, particularly at the primary care level. These include the clinical competence indicators as well as the process indicators, particularly in the Indonesia facility health survey. Further, Indonesia could also adopted the DHS Service Provision Assessment (SPA) survey that is currently not available in Indonesia.

Our results revealed that insurance coverage increased the use of high-level facility and specialised health care providers warrant continued policy discussion for several important reasons. First, the use of hospitals and medical specialists are skewed towards the richer population and women living Java-Bali region. Therefore, the expansion of JKN coverage might inadvertently lead to widen geographical inequities in maternal care use and outcomes. This is coupled by the significant deficit in clinicians and hospital beds especially in less developed regions (Mahendradhata et al. 2017; Meliala, Hort & Trisnantoro 2013; Anderson et al. 2014). Second, hospital-based delivery can be much more costly compared to deliveries at primary health care setting. As mentioned above, the JKN reimbursement for hospital-based normal delivery is tripled compared to the reimbursement for primary health care setting. Based on 2014-2019 JKN reimbursement data, the cost of normal deliveries occurring at the hospital level increased significantly over the year, from USD 26.9 million in 2014 to USD 64.2 million in 2019 (PKMK UGM 2019; BPJS Kesehatan 2018, 2020c). It is also important to note that the JKN program has been experiencing funding deficits since the start of its implementation in 2014, with its cumulative deficit now standing at USD 1.6 billion (BPJS Kesehatan 2020c).

Policies that encourage normal deliveries to occur at the primary health care setting and with good quality of care is important to improve efficiency, reduce inequities and financial sustainability of the national health insurance program. Strong health system underpinned by primary health care is also supported by the WHO as the core component in the effort to attain UHC in LMICs (Hone, Macinko & Millett 2018; Schwarz et al. 2020; van Weel & Kidd 2018). Several strategies to strengthen the capacity of primary health care include first, ensuring that Puskesmas have the human resource capacity and the infrastructure to provide services for normal deliveries (Ministry of Health 2019b). Second is by expanding the availability of inpatient Puskesmas, particularly in areas with limited access to secondary health facilities. And lastly to ensure that the quality of services provided at the Puskesmas,

for basic services as well as maternal and child health services, is equitable across the Indonesia regions. This could be done through investing in the mobilisation of human resources for health as well as in health infrastructure at the Puskesmas level.

Limitation

There are several important caveats of this study. First, Susenas dataset did not include the specific features of the type of birth attendant or the place of delivery, such as proximity, equipment or drug availability or costs associated with the different levels of care. This limits our ability in capturing quality factors that may influence women's choice directly. Another limitation is that we could not control for the medical conditions that the women had during the pregnancy or the known potential complications of the delivery. Women who, for example, have been identified to have high risk pregnancy, may opted or instructed to deliver at a hospital and attended by an OBGYN/GP. Further, previous review has stated that women may have difficulties in accurately identifying the different types of cadre for birth attendant (Radovich et al. 2019). Overreporting of attendance by doctors or OBGYN has also been recorded in few studies in LMICs with less-skilled providers such as midwives being underreported (Blanc, Diaz, et al. 2016; Blanc, Warren, et al. 2016; Stanton et al. 2013; McCarthy et al. 2016). In this study, which also relied on women's self-report, overreporting of attendance by higher-ranked providers such as GP and OBGYN may also occur and on the other hand, some women may have not accurately reported deliveries attended by non-skilled providers. However, there has been no study assessing the accuracy of women's self-report of birth attendants in Indonesia, which warrants further explorations.

CONCLUSION

Insurance coverage, type and region of residency as well as economic status of women determined the choice of birth attendant and place of delivery. The existing inequality in the use of specialised and high-level health care services may be worsened by the expansion of the national health insurance program. Strengthening the primary health care sector by ensuring the availability of qualified health workers and facility readiness should be prioritised in the effort of achieving the UHC and to help ensure the financial sustainability of the JKN program.

Manuscript 4 Table 1. Sample characteristics by types of providers and place of delivery, 2018

Variable	Total	Types of providers			Types of place of delivery			
	N = 41,460	OBGYN or GP (%) n = 12,108 (29.2%)	Midwife or nurse (%) n = 24,862 (59.9%)	TBA and other non-skilled attendant (%) n = 4,490 (10.8%)	Secondary facility (%) n = 12,891 (31.1%)	Higher primary (%) n = 12,451 (30.0%)	Lower primary (%) n = 5,865 (14.1%)	Home or others non-health facilities (%) n = 10,559 (25.5%)
Income quintile								
Poorest	25.68	19.20	68.75	12.05	19.85	31.69	22.88	25.58
Poor	22.10	25.03	67.62	7.34	26.37	34.32	18.81	20.50
Middle	19.80	30.94	63.95	5.11	31.87	35.38	16.06	16.70
Rich	17.03	42.50	54.91	2.60	41.34	33.58	13.81	11.27
Richest	15.21	61.10	37.86	1.04	58.37	29.15	7.77	4.71
Insurance status								
No insurance	30.22	20.69	69.49	9.83	18.72	34.11	21.69	25.48
JKN	63.83	36.52	58.27	5.21	37.77	32.88	15.12	14.23
Private insurance	5.95	60.40	38.68	0.92	57.57	27.64	9.74	5.05
Residency								
Rural	46.33	24.10	65.17	10.74	24.33	28.28	19.78	27.61
Urban	53.67	40.97	56.46	2.57	40.84	36.96	14.20	8.00
Region of residence								
Java-Bali	52.57	36.88	59.12	4.01	35.12	35.88	19.14	9.85
Sumatra	24.23	31.66	62.87	5.47	30.54	29.98	17.48	22.00
Kalimantan	6.80	27.54	63.67	8.79	31.82	28.94	11.93	27.76
Sulawesi	8.43	29.37	62.54	8.10	33.55	32.16	9.20	25.08
Eastern Indonesia	7.97	21.93	57.47	20.60	29.31	27.14	11.29	32.27
Education								
None	6.68	24.60	58.34	17.06	26.03	28.66	14.79	30.53
Primary	20.99	20.33	67.51	12.17	20.85	30.02	20.68	28.45
Secondary	57.16	33.18	63.10	3.72	33.12	35.69	17.80	13.39
Post-secondary	15.16	54.58	41.91	3.51	53.68	28.50	8.45	9.36
Women's work status								
Not working	66.90	31.10	62.47	6.43	31.19	33.93	17.37	17.51
Working	33.10	37.30	56.50	6.20	37.24	30.94	15.60	16.22
Maternal age								
<20 years	5.50	22.31	66.38	11.31	23.61	29.49	21.28	25.62
20-25 years	28.75	29.64	64.17	6.19	29.61	34.99	17.71	17.68
26-35 years	51.52	34.86	59.27	5.88	34.49	33.29	16.34	15.88
36+ years	14.23	38.27	55.24	6.49	39.43	28.86	14.78	16.93
Marital status								
Not married	1.68	25.60	61.97	12.43	24.78	34.84	17.50	22.88
Married	98.32	33.28	60.47	6.25	33.34	32.91	16.77	16.99

Note: Weighted for survey design

Manuscript 4 Table 2. Relative risk ratio (95% confidence interval) for the multinomial logistic regression fitted for the choice of birth attendant

Variable	OBGYN or GP		Midwife/nurse	
	vs TBA/other non-skilled		vs TBA/other non-skilled	
	RRR	95% CI	RRR	95% CI
Income quintile (ref: poorest)				
Poor	1.60***	(1.35, 1.89)	1.28**	(1.11, 1.48)
Middle	2.40***	(1.93, 2.99)	1.58***	(1.30, 1.94)
Rich	5.55***	(4.22, 7.32)	2.51***	(1.93, 3.27)
Richest	12.29***	(8.01, 18.87)	3.33***	(2.18, 5.09)
Insurance status (ref: no insurance)				
JKN	2.91***	(2.52, 3.36)	1.57***	(1.38, 1.78)
Private insurance	6.50***	(3.13, 13.51)	2.36*	(1.15, 4.87)
Residency (ref: rural)				
Urban	2.97***	(2.41, 3.66)	2.32***	(1.90, 2.85)
Region of residence (ref: Java-Bali)				
Sumatra	0.74**	(0.61, 0.90)	0.89	(0.74, 1.08)
Kalimantan	0.35***	(0.28, 0.45)	0.56***	(0.45, 0.70)
Sulawesi	0.59***	(0.47, 0.75)	0.72**	(0.58, 0.90)
Eastern Indonesia	0.19***	(0.16, 0.23)	0.28***	(0.24, 0.33)
Education (ref: no education)				
Primary	1.06	(0.84, 1.33)	1.42***	(1.18, 1.71)
Secondary	3.51***	(2.78, 4.45)	3.35***	(2.73, 4.10)
Post-secondary	3.67***	(2.81, 4.79)	2.14***	(1.69, 2.71)
Women's work status (ref: not working)				
Working	0.85*	(0.74, 0.97)	0.92	(0.82, 1.04)
Maternal age (ref: <20 years)				
20-25 years	1.55**	(1.15, 2.10)	1.49**	(1.15, 1.94)
26-35 years	1.63**	(1.22, 2.18)	1.39**	(1.09, 1.79)
36+ years	2.45***	(1.80, 3.34)	1.51**	(1.16, 1.98)
Marital status (ref: not married)				
Married	1.46	(0.99, 2.15)	1.52**	(1.11, 2.08)

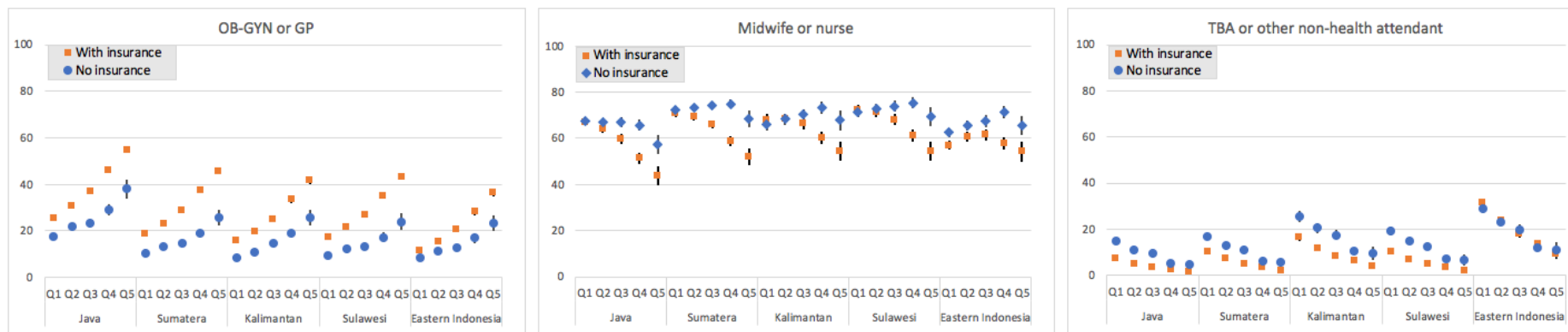
Note: Weighted for survey design; *significant at 10%; ** significant at 5%; ***significant at 1%.

Manuscript 4 Table 3. Predicted probability of patient choice of different delivery providers

Variable	Types of providers		
	OBGYN or GP (%)	Midwife or nurse (%)	TBA and other non-skilled attendant (%)
Income quintile			
Poorest	22.01	71.56	6.44
Poor	26.35	68.83	4.83
Middle	30.63	65.64	3.73
Rich	39.62	58.29	2.09
Richest	52.51	46.24	1.25
Insurance status			
No insurance	22.38	72.02	5.59
JKN	35.45	61.51	3.04
Private insurance	45.27	52.99	1.74
Residency			
Rural	28.30	65.97	5.74
Urban	34.59	63.05	2.36
Region of residence			
Java-Bali	34.65	62.51	2.84
Sumatra	30.37	66.26	3.37
Kalimantan	24.49	69.83	5.68
Sulawesi	29.92	65.92	4.16
Eastern Indonesia	24.57	64.89	10.55
Education			
None	29.16	62.51	8.33
Primary	24.16	69.32	6.53
Secondary	32.01	65.38	2.60
Post-secondary	42.94	53.72	3.34
Women's work status			
Not working	32.29	64.25	3.46
Working	30.49	65.68	3.84
Maternal age			
<20 years	27.87	66.90	5.23
20-25 years	29.16	67.31	3.52
26-35 years	31.60	64.77	3.63
36+ years	39.07	57.95	2.99
Marital status			
Not married	32.05	62.71	5.24
Married	31.68	64.76	3.56

Note: Weighted for survey design

Manuscript 4 Figure 1. Predicted probability of patient choice of different birth attendants, by insurance status



Manuscript 4 Table 4. Multinomial logit results for choice of levels of facilities

Variable	Hospital vs home/others		Higher primary health facility vs home/others		Lower primary health facility vs home/others	
	RRR	95% CI	RRR	95% CI	RRR	95% CI
Income quintile (ref: poorest)						
Poor	1.41***	(1.24, 1.61)	1.18**	(1.05, 1.33)	0.92	(0.81, 1.05)
Middle	1.84***	(1.59, 2.14)	1.37***	(1.18, 1.58)	0.93	(0.79, 1.08)
Rich	2.06***	(2.64, 3.56)	1.80***	(1.55, 2.09)	1.14	(0.96, 1.35)
Richest	6.32***	(5.14, 7.78)	2.56***	(1.07, 3.15)	1.24	(0.97, 1.60)
Insurance status (ref: no insurance)						
JKN	3.31***	(2.97, 3.68)	1.72***	(1.56, 1.90)	1.34***	(1.20, 1.49)
Private insurance	4.77***	(3.55, 6.42)	1.83***	(1.34, 2.49)	1.47*	(1.03, 2.09)
Residency (ref: rural)						
Urban	2.97***	(2.63, 3.35)	2.93***	(2.60, 3.31)	1.74***	(1.52, 2.00)
Region of residence (ref: Java-Bali)						
Sumatra	0.43***	(0.38, 0.49)	0.43***	(0.38, 0.49)	0.44***	(0.39, 0.51)
Kalimantan	0.33***	(0.28, 0.39)	0.31***	(0.27, 0.37)	0.25***	(0.21, 0.30)
Sulawesi	0.51***	(0.44, 0.59)	0.47***	(0.41, 0.55)	0.22***	(0.18, 0.26)
Eastern Indonesia	0.41***	(0.35, 0.47)	0.35***	(0.30, 0.40)	0.22***	(0.19, 0.26)
Education (ref: no education)						
Primary	0.78**	(0.66, 0.94)	0.94	(0.80, 1.12)	1.16	(0.95, 1.41)
Secondary	1.88***	(1.59, 2.23)	1.89***	(1.60, 2.23)	1.94***	(1.60, 2.35)
Post-secondary	2.71***	(2.23, 3.29)	1.89***	(1.55, 2.31)	1.42**	(1.12, 1.81)
Women's work status (ref: not working)						
Working	0.84**	(0.76, 0.93)	0.86**	(0.78, 0.94)	1.00	(0.90, 1.12)
Maternal age (ref: <20 years)						
20-25 years	1.22	(0.99, 1.52)	1.40**	(1.14, 1.71)	1.11	(0.89, 1.38)
26-35 years	1.37**	(1.11, 1.69)	1.40**	(1.15, 1.70)	1.10	(0.89, 1.37)
36+ years	1.95***	(1.55, 2.44)	1.38**	(1.12, 1.71)	1.07	(0.85, 1.35)
Marital status (ref: not married)						
Married	1.15	(0.84, 1.57)	1.01	(0.74, 1.38)	1.13	(0.80, 1.61)

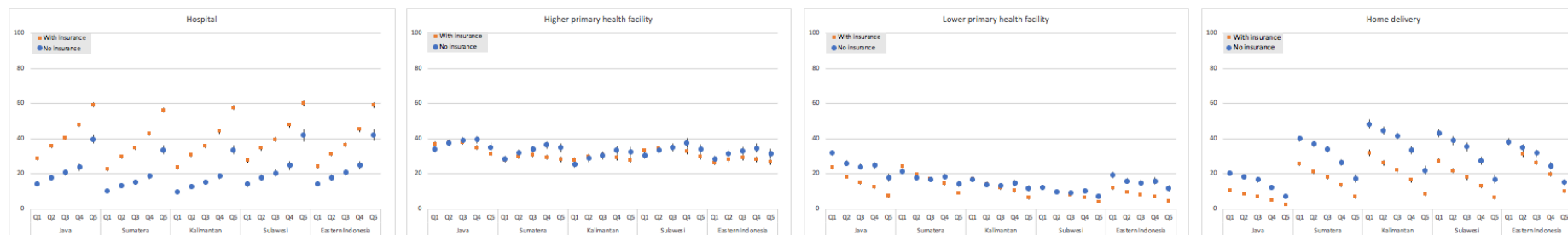
Note: Weighted for survey design; *significant at 10%; ** significant at 5%; ***significant at 1%.

Manuscript 4 Table 5. Predicted probability of patient choice of level of health facilities

Variable	Levels of facilities			
	Secondary facility (%)	Higher primary (%)	Lower primary (%)	Home or others non-health facilities (%)
Income quintile				
Poorest	23.24	36.03	22.91	17.82
Poor	28.77	37.19	18.46	15.59
Middle	32.66	37.58	16.17	13.59
Rich	39.52	36.06	14.53	9.89
Richest	51.50	32.28	9.97	6.24
Insurance status				
No insurance	21.25	38.12	20.99	19.65
JKN	38.26	35.77	15.26	10.70
Private insurance	45.78	31.45	13.90	8.87
Residency				
Rural	28.44	31.99	19.54	20.03
Urban	36.33	40.39	14.65	8.62
Region of residence				
Java-Bali	33.41	38.17	19.69	8.73
Sumatra	29.87	34.07	18.03	18.02
Kalimantan	29.98	32.75	13.41	23.86
Sulawesi	35.39	37.52	8.91	18.18
Eastern Indonesia	33.94	33.21	10.96	21.89
Education				
None	30.58	34.62	15.75	19.05
Primary	25.51	34.77	19.46	20.27
Secondary	33.34	37.92	17.70	11.04
Post-secondary	43.65	34.51	11.80	10.03
Women's work status				
Not working	33.68	37.42	16.40	12.50
Working	31.72	35.88	18.42	13.97
Maternal age				
<20 years	30.30	33.84	19.57	16.29
20-25 years	30.35	38.63	17.69	13.32
26-35 years	32.70	37.36	17.07	12.86
36+ years	41.23	32.74	14.65	11.38
Marital status				
Married	30.89	39.04	16.16	13.91
Not married	33.08	36.89	17.07	12.96

Note: Weighted for survey design

Manuscript 4 Figure 2. Predicted probability of patient choice of different health facilities, by insurance status



Chapter 9: Discussion

The analyses in this thesis identify and describe the factors related to the inequality in the utilisation of key maternal health care interventions in Indonesia. The first section summarises the principal findings as described through the manuscripts arising from this PhD research. The second section discusses the important insights that may have implications on health policy and systems research. The third section describes the strengths and limitations of the study. This discussion chapter concludes with a set of recommendations that emerge from this study, namely for Indonesia's national maternal health program and those which may inform the planning and development of health policies and programs in other low- and middle-income countries.

9. 1. Summary of main findings

Chapter 6 (Manuscript 1) presents the results from the decomposition analysis of the geographical gaps in skilled birth attendance utilisation across regions in Indonesia, which focuses on the contribution of disparities in the health supply-side towards the inequalities. Chapter 7 (Manuscript 2) explores the socioeconomic and geographical inequalities in four RMCH services utilisation over time by using the effective coverage framework. More importantly, Chapter 7 also highlights the levels of equity at different stages of coverage across different RMCH interventions and provinces in Indonesia, which aimed to highlight the different pathways towards high effective coverage levels. In Chapter 8, the focus was on assessing the impact of health insurance coverage on inequality in MCH services and outcomes. The following part summarises the main findings from Chapter 6, 7 and 8.

The first manuscript shows that the disparities in the coverage of skilled birth attendance (SBA) across regions in Indonesia were mainly due to the variations in human resources and hospital beds availability. Java-Bali had the highest coverage of SBA (96.0%) while the largest gap was observed between Java-Bali and Eastern Indonesia at 16.6%. The availability of all supply-side variables was also the highest in Java-Bali region and lowest in Eastern Indonesia. Due to these differences, a large proportion (80.5%) of the gap in SBA coverage between Java-Bali and Eastern Indonesia was attributable to the differences in the supply-side variables. These findings imply that challenges in mobilising human resources for health and health infrastructure development in less-developed regions should be the priority in addressing geographical inequality in maternal health service utilisation.

However, the number of Puskesmas that were certified as able to provide standardized care was negatively associated with the use of SBA. In effect, the variations in the number of these Puskesmas contributed negatively towards the gap. Or in other words, increasing the number of Puskesmas in Eastern Indonesia to the level of that in Java-Bali would be predicted to actually worsen the geographical inequality. This implies that the physical availability of Puskesmas did not translate to better access to maternal health services,

which may relate to low quality services rendered at these facilities. The remaining differences in the SBA coverage between Java-Bali and Eastern Indonesia were explained by variations in the socioeconomic characteristics across the regions, including maternal education and the household income and living conditions. This implies there is room for improving SBA coverage through investing in maternal education and improving household economic status.

The second manuscript presents the current situation and trends over time in the coverage of four RMCH services (family planning, ANC, maternal delivery service and childhood immunisation) using the effective coverage framework. The study also documents the different pathways towards high coverage levels with respect to distribution of services, by analysing levels of equity at different stages of coverage across Indonesian provinces over time. The results show consistent improvement in the levels of crude coverage of family planning, ANC, maternal delivery and childhood immunisation over time. However, the quality-adjusted coverage of these services remained low. This implies that first, relying on crude coverage to monitor the progress of health service delivery may not reflect the actual health benefits that are expected from these services. And second, there is a need for strengthening health policies that concentrate on quality RMCH services.

For family planning and ANC, the largest drop of coverage along the effective coverage cascade was observed between crude coverage and the quality-adjusted coverage. For maternal delivery service, the largest gap was between service contact and crude coverage, while for childhood immunisation between quality-adjusted coverage and user-adherence-adjusted coverage. These imply the need to tailor health policies based on the types of RMCH services and the main challenges for each intervention.

As expected, inequity in service utilisation diminishes as the overall coverage increases. And as such, measuring equity based on service contact or crude coverage alone masks the magnitude of the inequities in the quality of the services received across the socioeconomic groups. Larger disparities between the rich and poor populations were observed in provinces with lower coverage. Based on the latest Indonesian DHS 2017, the concentration indices for service contact were close to zero and became more pro-rich for user-adherence-adjusted coverage for family planning, antenatal care and childhood immunisation services. Maternal delivery crude coverage was also more inequitably distributed across the wealth quintiles compared to service contact. The rich-poor gap based on provincial-level performance showed that equity was only achieved in provinces with very high levels of overall coverage. Based on the plotting of the concentration index and provincial-level coverage, we observed a trend for ANC and maternal delivery where equity was only achieved at a very high-level of overall coverage. In contrast, family planning and childhood immunisation services were more equitable even at the lower level of coverage. These findings imply that there could be different distributional pathways to achieving high coverage levels of RMCH services. These findings also highlight the possibility of achieving high coverage levels without compromising health equity.

The third and fourth manuscripts assessed the effect of the health insurance program on maternal health care use, child mortality and women's choices in birth attendant and place of delivery. In the third manuscript, an interrupted time-series design was used to assess whether the implementation of the national health insurance program was associated with changes in the coverage of maternal health services (ANC4+, SBA, institutional delivery and caesarean section) as well as in neonatal and infant mortality rates. The study showed that the implementation of JKN in 2014 was associated with a significant increase in the coverage of ANC4+, SBA and institutional delivery. However, no significant increase was observed for caesarean section nor improvement in neonatal and infant health outcomes following the implementation of the JKN program. Given that neonatal health outcomes correlate with the quality of three of the interventions included in the study, i.e. ANC, SBA and institutional delivery, the findings imply that the increase in the coverage levels of these interventions following JKN introduction was not accompanied by improved quality of care.

The fourth manuscript assessed the synergistic effect of socioeconomic status, geographical region and insurance coverage status on women's choice in birth attendant and place of delivery. This manuscript is the first in Indonesia to assess different types of birth attendants and levels of health care facilities. The analyses showed a larger effect of having insurance coverage on the probability to choose to deliver with an OBGYN/GP and at secondary health facility over choosing to be attended by a midwife/nurse or to deliver at a primary health facility. In other words, having insurance coverage increases the likelihood of women to deliver with medical specialists or at a secondary facility. While these results imply that women are supported by an insurance coverage to access services where they are currently likely to be more effective, it raises questions about the sustainability of achieving universal maternal coverage in this way. It is likely that sustainability will require greater use of primary care, and midwife-supported care for normal deliveries in the long term.

There was also a large synergistic effect of insurance coverage, region of residency and economic deprivation on women's choice of birth attendant and place of delivery. The highest probability of choosing OBYGN/GP was among insured women living in Java-Bali and from the richest wealth quintile and lowest among uninsured women living in Eastern Indonesia and from the poorest wealth quintile. Insured women living in Sulawesi and from the richest wealth quintile had the highest probability of choosing to deliver at a hospital, while the lowest probability was observed for uninsured women living in Kalimantan and from the poorest wealth quintile. Region of residence played a significant role in women's choice of type of birth attendant. For instance, insurance coverage had no effect in reducing the likelihood of choosing TBA for women living in Eastern Indonesia, regardless of wealth status. This implies that in a country like Indonesia with unaddressed geographical variations in health supply-side readiness, removing financial barriers to health services might worsen inequity in health outcomes. Further, insurance coverage may also have an unintended consequence, that is driving patients away from primary care and the overutilisation of hospital-based services.

9. 2. Strengths and limitations of the studies

The studies included in this thesis used the most current multiple data sources that are nationally representative and multiple methods of analysis for each research question, to improve the robustness of the findings. To my knowledge, Manuscript 1 on decomposing geographical inequality in SBA utilisation is the first study that assessed disparities across regions in Indonesia that takes into account not only the demand-side variables but also health system supply-side. Previous studies that assessed geographical variations in maternal and child health service utilisation or outcomes have either been limited to particular regional or local settings (Mutiarra 2017; Rahayu & Indiati 2017; Marniyati, Saleh & Soebyakto 2016), or to demand side variables (Tripathi & Singh 2017; Houweling et al. 2006; Hodge et al. 2014). The decomposition methods used in Manuscript 1 was also tested for robustness using a set of sensitivity analyses that confirm the findings.

In manuscript 2, I used the effective coverage framework that offers more detailed insights into the quality of care rather than the usual crude coverage estimation in monitoring the progress in RMCH service coverage in Indonesia. The effective coverage framework is not entirely novel but may serve as a comprehensive framework that allows for cross-country comparisons over time. More importantly, the study contributes to the growing discussion on the pathways to achieving health equity in relation to improving RMCH service coverage within the country and across regions.

There are several caveats to the studies. First, the results may be affected by known limitations relating to secondary data collected from household surveys. These include measurement errors and potential recall bias. To address this limitation, the observation was limited to only the most recent birth that occurred in the last 3-years prior to each of the survey waves. Second, data are lacking pertaining to access to and other information on the readiness level of the facilities data. For instance, Indonesia DHS and the Susenas surveys did not collect measures of distance to facility, which is an important determinant of health care use (Hanson et al. 2015; McKinnon et al. 2014). Further, variables on the quality of care provided by the facilities that may be accessible by the respondents were also not collected. Together, the possible recall bias and the lack of information on health facilities may limit the interpretations related to the quality of care that was integral to Manuscript 2.

This thesis only includes information from the users' perspective. Including physicians', midwives' and nurses' perspectives would enrich the information relating to barriers in utilising quality RMCH services. Health care providers, particularly from less-developed regions such as Eastern Indonesia, might be able to provide information that could enrich the understanding of why inequitable access persists even after the implementation of various supply-side programs and the introduction of JKN in Indonesia. Further, providers would also have different insights on how JKN has affected their work burden, quality of care and other changes in their health facilities.

There are also several limitations in relation to the methods for the analyses included in this thesis. The first manuscript on assessing geographical inequality in skilled birth attendance utilisation used the decomposition analysis. The most notable limitation of the non-linear decomposition analysis lies within the sensitivity of the results to the choice of the reference group. For instance, if the reference group was changed from Java-Bali to Eastern Indonesia, it would change the effect of the variables and the intercept. In order to address this, the manuscript applied Neumark's (1988) and Oaxaca and Ransom's (1994) specification where coefficient estimates from a pooled logistic regression of both the reference region and the region of interest were used. The decomposition analysis results also do not imply any causality of the geographical inequality and its determinants included in the study.

Further, in the second manuscript, the analyses applied equal weighting to all clinical components of the maternal health services. It may be worth exploring different clinical importance of the components, e.g. if assessing for proteinuria to ensure early diagnosis of pre-eclampsia is more clinically important than checking the height or weight of the pregnant women.

In the third manuscript on the assessment of the association between JKN implementation and maternal health service utilisation and child mortality, the ITS approach was used. The first methodological limitation would include the time period of the observations following JKN implementation. While the datasets used allowed for more than 9 observation points after JKN introduction, a longer time period would benefit from capturing the long-term effect of JKN. This may also partially explain the non-significant results found in the association between JKN and neonatal and infant mortality. There is also a possibility of other existing programs that may be implemented during the same period of the JKN introduction and with the non-existence of a suitable control group, the study could not assess independent impact of the programs. However, as mentioned in the Limitation section of manuscript 3, I was not aware of any national programs on MCH that may affect the utilisation in maternal health care service as well as on child mortality in Indonesia. Finally, in the fourth manuscript, the analyses could not include other factors that may influence women's choice in place of delivery and type of birth attendant. These may include the perceived quality of different types of health facility and the health conditions of the respondents.

9. 3. Implications for public health policy

The findings of the studies included in this thesis indicate complex issues within the health system that interact with each other. These include the supply of health services and challenges in addressing this issue in regions such as Eastern Indonesia that have consistently lagged behind in health service coverage and outcomes. While the health supply-side issue affects the quality of RMCH services, it may also affect the perceived quality that then determines the health care-seeking behaviour. This was seen through the variations in the effect of human resource and health facility availability across the

Indonesian regions. Further, demand-side interventions such as the removal of financial barriers through the expansion of social health insurance could improve service coverage. However, the effect of the policy is shown to vary across regions and may have unintended consequences for health equity. Without first improving the capacity of the health system to provide additional and high quality care, the policy could overwhelm local health systems or compromise the quality of health services.

As the findings presented in this thesis highlight, regional variations in health supply contributed significantly to not only the use of quality RMCH services but also affected the impact of social health insurance. The first set of policy recommendations relates to improving health supply-side readiness. Recommendations around primary health care strengthening in the context of JKN implementation are also presented. Lastly, the section presents recommendations on health service delivery methods that could be considered in improving health equity while increasing the coverage of RMCH services. The recommendations take into account the decentralised health system and the regional variations in Indonesia in terms of health system capacity. The purpose is to avoid one-size-fits-all policy recommendations.

9. 3. 1. Improving the accessibility to quality health services

Human resources and health facilities

As reflected in Manuscript 1, the availability of human resources for health and health facilities is an important determinant in the utilisation of key maternal health care service in Indonesia. Manuscripts 2 and 4 have also highlighted the geographical disparities in health care service utilisation between the well-developed region of Java-Bali and the less developed regions. The inequity in the availability of health resources across the Indonesian regions also contributed to the geographical disparities in maternal health care utilisation. This section provides critiques surrounding the issue of health resource provision in Indonesia and the possible strategies that could address the challenges.

The health sector is one of the main development areas for the Indonesian government. This is shown by a consistent increase in the budget allocation for health, from 4.5% of the general government expenditure in 2010 to 8.7% in 2017 (World Bank Group 2020b), as well as increase in the availability of human resources and health facilities (Mahendradhata et al. 2017; Rokx 2010; Anderson et al. 2014; Indonesia MOH 2020). The central government also commits to increasing the health budget allocation by targeting at least 5% of the national-level government budget is allocated to health programs, after excluding allocation for public health workers' wages. For sub-national government, the allocation was targeted at 10%, also after excluding public health workers' wages (Republic of Indonesia 2009). While the majority of provinces and districts have met the target (Ministry of Finance 2020a), the effectiveness of the budget allocation is hampered by issues in the planning process, the actual implementation of health service delivery and low budget realisation. For instance,

between 2010-2019 the Ministry of Health budget absorption was only around 80% (Ministry of Finance 2020a).

The government has also issued several key policy documents outlining the national health strategies, which serve as the bases for improving health service provision. One of the key documents is the mid-term planning document for health (Rencana Perencanaan Jangka Menengah Nasional or RPJMN on Health). The RPJMN outlines the targets for health output indicators (e.g. health outcome indicators), process indicators (e.g. intervention coverage) and inputs (number of health facilities and human resources). The RPJMN should be translated into the local government's midterm planning documents to ensure that national-level goals are supported by implementation at the province and district levels. However, there are still issues in the planning and mobilisation of health service delivery in Indonesia.

The first issue relates to the bureaucratic and complex processes for health resource planning. In practice, a top-down planning approach has dominated the health sector even after the decentralisation of the health system that took place in 2000 (Heywood & Harahap 2009; Heywood & Choi 2010). The majority of funding for health services still comes from the central government budget. For instance, procurement of health facilities is still mainly financed through the national level budget. While district and provincial governments have the ability to request or propose health facility procurements, many of the national budget lines are earmarked for specific health facilities that may not be appropriate to local needs. The budget structure also limits the ability of sub-national governments to tailor their health service delivery model to suit the local conditions. As an illustration, between 2011-2019, the national government has set up more than 180 Puskesmas in four Eastern Indonesia provinces (Maluku, North Maluku, Papua and West Papua) (Indonesia MOH 2020). However, the planning and procurement of these Puskesmas were not accompanied by sufficient recruitment and mobilisation of health workers to the provinces. This resulted in 50% of Puskesmas without a sufficient number of health cadres, particularly doctors. Such disparities were also captured in results presented in Manuscript 1, where lower availability of health human resources and facilities in Eastern Indonesia compared to the Java-Bali region largely explained the regional gap in SBA coverage.

In order to address issues around health human resources and facility planning, sub-national governments should be given more authority in the planning process. This can be done by still using the RPJMN and the RPJMD as the legal guidance so that sub-national governments meet the national and local health targets, but giving more flexibility in allocating the budget that comes from the national transfer. This would require a significant improvement in the planning and budgeting capacity of the district and provincial health offices. However, previous studies (Jimenez Soto et al. 2013; Heywood & Choi 2010) have documented the issues in strengthening the capacity of local government, including in planning and budgeting for health. This mainly relates to the decentralisation of the government including the health sector that took place in 1999.

The government decentralisation was implemented at the district level and not at the provincial level. Past political turbulence has driven such design, as widely documented elsewhere (Kristiansen & Santoso 2006; Lieberman, Capuno & Van Minh 2005). For the health system, the decentralisation has impacted the governance at all levels, including in planning and budgeting for health resources, the actual implementation of the health programs, and in the monitoring and evaluation of those programs. Provincial-level government has no longer the capacity or the perception that they are responsible for the certain number of districts within their jurisdiction. Planning and budgeting for many public services, including health services, have been historically disintegrated with little harmony between the national and sub-national levels. To address this, Indonesia would need to seriously invest in building the capacity at the lowest level of the government system. One alternative is to reinforce or rejuvenate the capacity and mandate of the provincial level to oversee (and also to provide responsive actions based on continuous monitoring and evaluation or assessment) how districts and sub-districts perform in their effort to provide better and equitable health services.

Equitable distribution of human resources for health is an ongoing challenge in Indonesia. Both national and sub-national governments can recruit and incentivise human resources for health, through different sources of funding resulting in different amounts of incentive. For remote and very remote areas, the Ministry of Health has recently introduced the Nusantara Sehat (Healthy Archipelago) program (Ministry of Health 2018). The program aims to recruit health workers to Puskesmas in underserved areas using a team-based approach. The team consists of a doctor, a dentist, a midwife and a nurse, a public health professional, a nutritionist, a pharmacist and a laboratory technician. For the program, recent graduates from health educational institutions were recruited and assigned as a team to designated Puskesmas for a period of 2-years. New teams are deployed annually to ensure the continuous availability of health workers. The program has the potential to fill the gap in the availability of human resources for health and address inequity in access to health services. After 5 years of its implementation, the program has shown some benefits, including improved patient contact rates and outreach services as well as increased coverage in both curative and promotive health services (Sitepu 2019). Between 2015 and 2019, 3,380 health workers have been deployed to 475 Puskesmas in 163 underserved districts. However, evaluation studies of the Nusantara Sehat program highlighted several issues that need to be addressed if such programs are to be continued (NIHRD 2017; Sari, Hendarwan & Halim 2019).

The issues include the limited infrastructure of the Puskesmas where the teams were deployed. This also reflects the lack of integrated planning between the MoH and local health offices. Ideally, human resource mobilisation should be accompanied by infrastructure improvement. Lack of supervision and ongoing training from local district health offices as well as the MoH were also found. Further, the health workers were also concerned about the continuity of their career post-placement. Currently, there is no clear

career pathway provided through the program and all health workers have to apply for employment following their contract with Nusantara Sehat program. District health offices (DHOs) have also expressed their concern regarding the sustainability of the program and that the team-based approach does not always suit the need of their Puskesmas. For instance, the majority of Puskesmas in East Nusa Tenggara, including the remote ones, are sufficiently staffed with midwives and nurses but lacking in doctors (NIHRD 2017). However, Nusantara Sehat program would still deploy the full team to all targeted Puskesmas. And the short-term deployment of 2-years increases high turnover and more adjustment periods required for the team to fully function at the Puskesmas. These issues are not exclusive to Nusantara Sehat program and thus, addressing them would also benefit other recruitment strategies in Indonesia. Finally, there is no robust evaluation study on Nusantara Sehat that assessed its impact on the quality of services provided or on health outcomes of the population.

The salary provided by the Nusantara Sehat program ranged from USD 314 for non-doctor cadres to USD 560 for doctors and dentists. While the amount is sufficient to cover daily expenses, it is not sufficient to compete with higher salaries offered by richer provinces or districts. For instance, since PHOs and DHOs can allocate resources for the recruitment of health workers, Jakarta province has started a massive recruitment exercise for doctors, midwives and nurses (Jakarta Province Health Office 2016). This was done as part of the province's program to equip each sub-district with door-to-door health services and improve public health outcomes. This program offers a monthly salary at around USD 1,400 for a GP, much higher than any other province could afford including that of the MoH's Nusantara Sehat program. Further, health workers living in Jakarta could enjoy all the comfort and supporting facilities available in the capital city. Such imbalanced competition within the health labour market is a complex issue. One approach is to centralise the wages, but when the wage rates fail to capture regional differences in job attributes and environmental conditions, it may result in local shortages and surpluses (McPake & Edoa 2014). Further, the public-private mix in the Indonesian health care setting would not allow for centralisation of wages. Another option could be to allocate an earmarked budget to compensate wages for health workers in underserved regions.

Indonesia could adopt the comprehensive strategies implemented in Thailand to ensure equitable distribution of doctors in rural areas, in particular, to increase and intensify the development of rural health infrastructure. In 1979, Thailand shifted significant resources from cities to rural districts. This resulted in the rapid increase in the numbers and capacities of rural district hospitals (Wibulpolprasert & Pengpaibon 2003). Such enabling environment is part of the strategy to incentivise the necessary health workforce increase, which is still lacking in rural and remote areas of Indonesia (Rajan et al. 2018). The other strategy that needs to be adopted is the comprehensive rural recruitment that would improve the likelihood of workforce retention in rural areas. While Indonesia has implemented a similar approach to recruit students from less developed provinces, in

practice, most of these students come from the capital city and not from the rural areas within the provinces. Further, recruitment is mainly driven by the central government. The local government's financial support for these students is also limited. Thus, the recruitment process should be led by the provincial government using information from the district governments (who would have more understanding of the context of rural setting) and with the support (financial or regulatory) from the Ministry of Health.

Practical training for medical students in rural and district hospitals has also been proven to increase students' familiarity with the rural environment in Thailand (Wibulpolprasert & Pengpaibon 2003). Mandatory placement in rural areas has resulted in higher retention rates of doctors in Thailand. Two-thirds of graduates continued their rural placement following the compulsory placement (Wibulpolprasert & Pengpaibon 2003; Wibulpolprasert 2001). As discussed in Chapter 3, Indonesia also has a similar mandatory program called the Pegawai Tidak Tetap (PTT) or health worker contract scheme that hired recent medical graduates as contractors to serve in remote and very remote areas. The PTT program has evolved over the years as an effort to improve equity in the distribution. However, the frequent changes to the policy reflect that the current contract arrangements have not satisfied health workers. Understanding the specific factors that affect the willingness to move and stay in underserved areas in Indonesia is needed. These factors need to be addressed by local governments as they would have better insights into local needs and challenges.

Thailand has also gone through the necessary reforms in medical education to ensure the competence of doctors. Rural doctors also receive special quotas to pursue medical specialist training, and rural placement has become a prerequisite for the residency training programs. Furthermore, rural doctors who have served for at least five years in Thailand are eligible to apply for qualifying board examination for the specialty in preventive medicine, general practice and family medicine.

High quality and highly subsidised medical education, targeted recruitment and early exposure to the rural health system as well professional recognition strategies that were implemented in Thailand could be adapted into the Indonesian context. The adaptation, of course, should recognise the diversity of geographical and political contexts as well as the size of the population and cultural differences across Indonesian regions.

Delivering and measuring quality RMCH services

Public health policies and programs should be geared towards improving access and coverage of quality health care services, rather than access alone. One of the key policies evaluated in this thesis was the Indonesia national health insurance. The JKN is one of the largest investments in the health sector in Indonesia. The Indonesian government's spending on JKN has increased significantly since its launch in 2014. The latest data show that in 2019, the Indonesian government spent around USD 3.9 billion on JKN and this increased to USD 5.7 billion in 2020 (Ministry of Finance 2020b). These translate to 47.3%

and 61.3% of the total government spending on health in 2019 and 2020, respectively. Such large investment in health should be geared towards ensuring equitable access to not just health services, but to quality health care that would improve population health outcomes.

The results presented in Manuscript 3 show that JKN implementation was associated with a significant increase in the coverage of ANC4+, skilled birth attendance and institutional delivery services. As the JKN program removes financial barriers associated with health care use, these results are expected and are in line with other studies (Aggarwal 2010; Aji et al. 2013; Anindya, Lee, McPake, Wilopo, Millett, et al. 2020; Qin et al. 2019). However, after 3-years of its implementation, the JKN program implementation was not associated with neonatal nor infant mortality reduction. While neonatal mortality is influenced by a wide range of factors, from biological to socioeconomic determinants at individual, household and community levels (Baqui et al. 2016; Barros et al. 2005; Tura, Fantahun & Worku 2013; Kolola et al. 2016; Titaley et al. 2008), it also correlates with the quality of ANC4+, SBA and institutional delivery (Raven et al. 2012; Tunçalp et al. 2015; Raven et al. 2012). And thus, the findings indicate that the JKN program might not be adequately supported with quality of care improvement.

Manuscript 2 on the RMCH effective coverage provides further evidence on the low quality of care in RMCH services in Indonesia. The study showed gradual increase in the crude coverage levels of family planning, ANC, maternal delivery service and childhood immunisation between 2002 and 2017 in Indonesia. For instance, antenatal care national crude coverage, or the ANC4+, has reached a very high level at 97.3%. However, the quality-adjusted coverage was very low, only 10.0% for family planning, 25.6% for ANC and 44.8% for childhood immunisation. Such gaps between the crude coverage and quality-adjusted coverage could help explain the components of services that are missing and should be addressed in order to provide comprehensive maternal and child health services in Indonesia.

The measurement of the quality of RMCH services is also an important avenue for Indonesia and other LMICs. Promoting the use of indicators that could effectively capture the quality aspect of RMCH services is important. Further, there is also the need to move away from monitoring RMCH programs based on crude coverage alone. However, using intervention crude coverage as a monitoring indicator still dominates. For instance in Indonesia, the Ministry of Health has issued several regulations and standard procedures outlining essential components of ANC. The regulations mandated that all district and province health offices should adhere to meeting these standards. However, in the monitoring and evaluation of ANC coverage, health reports in Indonesia only include the ANC4+ or the crude coverage of the service. This limits the ability to identify the gaps in the quality of the service and to improve specific components of the services. And thus, collecting and reporting all of the essential components of the RMCH services as part of national program monitoring and evaluation is pertinent.

Health service delivery models

Increasing the availability of health workers and facilities to address health inequalities between rural, remote and more developed regions in Indonesia may not be sufficient. There are several health service models that could be considered for regions with geographical challenges and limitations in health resources.

The first is to bring services to the community to increase accessibility and acceptability. This can be done by working with community health workers (CHW) who are not formal health professionals but are provided with some level of health training and are typically recruited from the local community. Previous evidence has shown that CHWs that are provided with small salaries, on-site training and a supplies package as well as fortnightly supportive supervision have contributed to the increase in SBA and family planning coverage in rural Pakistan (Hafeez et al. 2011; Douthwaite & Ward 2005), decreased care-seeking for child illness and reduced under-5 deaths in Nepal and Ethiopia (Pandey et al. 1991; Ali et al. 2005). The CHW program could be successful as it bridges the potential cultural gaps between the local community and health care providers. However, the CHW model poses some challenges including the recruitment of CHWs to serve in very remote areas, and in some countries, the model can be more expensive than standard rural primary healthcare services (Rotheram-Borus et al. 2011; Fort et al. 2011).

Indonesia's CHW program was also a success story particularly in the early implementation of the family planning program (Hull, Hull & Singarimbun 1977; Hull & Hull 1977; Smyth 1991). At its peak, Indonesia's family planning program resulted in an increase in contraceptive prevalence from 5% to over 50% between 1960 and 1990. Within the same period, the total fertility rate (TFR) was halved. Community health workers played an integral part in the program, mainly as the bridge to raise awareness and increase access to contraceptives through connecting women to health care providers. However, the program that was previously fully endorsed and financed by the central government, stagnated following the decentralisation of the health system (World Bank 2020f). Part of the cause was the significantly reduced funding for family planning programs and low adoption by the sub-national governments, which also led to diminished support for the CHWs. Apart from the specific challenges faced by Indonesia's family planning program, the CHW model has been demonstrated to improve access and use of health services, including in remote settings in Indonesia. Rejuvenating a similar approach through improving the political and funding support of the local government could have the potential to benefit not only family planning services but also other MCH services.

Task-shifting is also a strategy that has increased the availability and acceptability of RMCH services. Previous studies have shown that using auxiliary nurse-midwives who are trained to provide intrauterine contraceptive device (IUDs) increase the coverage of IUDs by 400% and with low complications in rural Guatemala (Vernon 2009). Training of community-based reproductive health workers in Ethiopia has also increased the uptake of modern contraceptives and appealed to a segment of the population who had never used modern contraceptives, i.e. older women, with higher parity, unmarried, and with low education as

they prefer the community-based workers to more senior clinic-based health workers (Argaw, Fanthahun & Berhane 2007; Prata et al. 2011). Task-shifting has also been implemented in cases of emergency obstetric care, where non-physician clinicians have been trained to perform emergency caesarean without compromising the quality of the services (Dawson et al. 2014; Bergström 2015). However, in Indonesia, task-shifting for MCH services is still limited and mainly hindered by the existing regulations regarding medical practice and opposition from the medical professional associations. Regardless, task-shifting, especially to improve access to Comprehensive Emergency and Obstetric Care (CEmOC) services, is another strategy that could be suitable for remote and underserved areas in Indonesia.

Other strategies for health service delivery that could be adapted to remote and underserved regions in Indonesia may include home-based administration of misoprostol by CHWs that has been proved to safely lower the incidence of postpartum haemorrhage and reduce the severity of delivery complications (Abbas et al. 2020; Smith et al. 2012; Blum et al. 2012). Maternity waiting homes, which are usually located close to health facilities could also address some of the geographical barriers in accessing quality MCH services. However, the implementation of maternal waiting homes is not well evaluated with limited or mixed evidence of its effectiveness (van Lonkhuijzen, Stekelenburg & van Roosmalen 2012; Penn-Kekana, McPake & Parkhurst 2007; Byrne et al. 2014).

Regional variations in RMCH service coverage that were shown in this thesis, implying that the service delivery model should acknowledge local contexts and health system readiness variations across the regions. Any service delivery model that is adapted should take into account the context of the districts and provinces. For instance, while maternal waiting homes may work to some extent in improving SBA coverage in rural Sumatra or Java (Dari, Zulfendri & Aulia 2019; Pujihartati, Demartoto & Wijaya 2019), it may not be culturally appropriate in other regions. Task-shifting for CEmOC services on the other hand, could work well in underserved areas. And thus, policies or regulations should accommodate region or province-specific policies.

With regard to attaining health equity, the findings presented in Manuscript 2 show different levels of inequity in relation to service coverage across different RMCH interventions. Inequity in access to antenatal care and maternal delivery was only reduced when the overall coverage level reached high levels, which is unsurprising and in line with previous studies (Neal et al. 2015; Channon et al. 2013). On the other hand, family planning and childhood immunisation services were more equitably distributed across economic strata even when the overall coverage was relatively low. In Indonesia, both family planning and childhood immunisation are mainly delivered through community-based programs, including those involving CHWs mentioned above and other community outreach programs. On the other hand, ANC and maternal delivery rely heavily on facility-based service delivery, which may explain limited coverage in areas with low health resources availability and larger socioeconomic inequalities. As such, integrating some MCH service deliveries into a more

community-based model may be able to improve the uptake of the services without compromising health equity. As the thesis did not elaborate on how the actual implementation of family planning services or childhood immunisation at the field level and whether the service delivery model did in fact (or how it) affected the equity in health service use, further investigation is warranted. It would also be interesting to see if similar patterns of equity and coverage levels are observed in other LMICs and across other RMCH services. This would contribute to the growing discourse on improving health equity in the context of universal health coverage.

9. 3. 2. Strengthening primary health care to achieve quality universal health coverage in the context of national health insurance program

Strengthening RMCH at the primary healthcare level should be a priority for countries to attain the Sustainable Development Goal targets for improving maternal and child health outcomes and achieving health equity. Focusing on investing in primary health care would also improve the efficiency of the health system. However, based on the results presented in this thesis, the availability of Puskesmas was not associated with higher use of SBA and JKN coverage has instead increased the likelihood of hospital-based deliveries and may result in inefficient health spending. This section discusses how the results in the thesis support the growing global agenda to strengthen primary health care to achieve UHC and in the context of the national health insurance program.

Results presented in Manuscript 1 on the decomposition analyses of geographical inequality in SBA coverage showed that the number of inpatient Puskesmas that are able to provide standard services at the provincial level was not associated with higher likelihood of the use of SBA. The number of Puskesmas was even negatively correlated with the use of SBA based on the regression results for Java-Bali and Eastern Indonesian regions. This implies that after controlling for other variables, provinces with higher numbers of Puskesmas actually have lower SBA coverage. Furthermore, the decomposition analyses for regional gaps in SBA use between Java-Bali and Eastern Indonesia show that the variations in the number of Puskesmas between the two regions contributed negatively towards the gap in SBA coverage. This finding implies that should Eastern Indonesia have the same number of Puskesmas per province as Java-Bali has, after controlling for other variables, the gap in SBA coverage would actually worsen.

While the negative association between Puskesmas and SBA use might be due to Puskesmas being correlated with the rurality of the region, population density or the development level of the province, it is also plausible that patients' perception of the quality of the Puskesmas may affect the likelihood of using MCH services. The sensitivity analysis presented in Manuscript 1 that used the total number of Puskesmas —instead of only inpatient Puskesmas that were able to provide standard services— yielded an even larger negative coefficient towards the likelihood of SBA utilisation. This result may support the assumption that women's health-seeking behaviour during pregnancy and delivery was not associated with the mere physical presence of Puskesmas.

In contrast to the results on Puskesmas, SBA use was positively associated with the number of other health resources, i.e. health workers (doctors and midwives) and hospital beds. In effect, the decomposition analysis showed that the regional variations of health workers and hospital beds contributed positively towards the geographical gaps in SBA use. Hospital beds, in particular, contributed towards the majority of the geographical gaps in SBA use, 22.2% for gaps between Java-Bali and the rest of Indonesia and 83.8% for gaps between Java-Bali and Eastern Indonesia. These results might imply that increasing the number of hospital beds and skilled birth attendants should be prioritised to close the geographical gaps in SBA coverage. However, there are a number of problems with that conclusion.

First, inpatient Puskesmas in Indonesia are mandated and designed to be able to provide services for normal deliveries (Ministry of Health 2019b), which are the majority of maternal delivery cases. Second, investing in primary health care is more cost-efficient compared to procuring hospitals in every sub-district in Indonesia. The cost associated with health service provision at the secondary level of care would also be significantly higher, resulting in inefficient spending within the health system. And third, there are around 10,000 Puskesmas spread across all districts in Indonesia, 60% of these Puskesmas with inpatient capacity. This means that the majority of the population already has access to health facilities that have the potential to provide quality health services. And thus, improving the quality and readiness of these Puskesmas might be a more cost-effective and sustainable strategy.

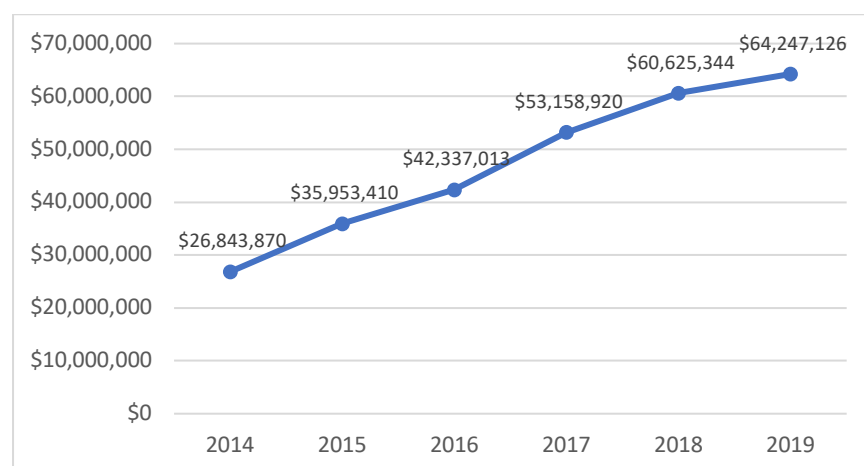
The results presented in Manuscript 4 also indicate that JKN coverage increased the likelihood of women's choice of hospital-based delivery and assistance by OBGYN/GP. Compared to women who were uninsured, having JKN coverage increased the probability of choosing OBGYN/GP as birth attendant by 13.1% and by 17.0% for hospital-based delivery. On the other hand, the insurance coverage seemed to decrease the probability of women's choice to deliver at the primary health care setting. This implies that under its current implementation, even though the majority of deliveries are without complications, the JKN program is increasing the use of secondary health facilities for deliveries with minimal effect on the use of primary health facilities. And this may contribute to inefficient health spending, as discussed previously.

Strengthening the primary health care sector and improving the capacity of primary health facilities would also improve the cost efficiency of the national health insurance budget. Based on previous analyses using 2015 and 2016 JKN sample datasets on hospital reimbursement, around 20.1% of delivery-related cases that occurred at hospitals were reimbursed as normal deliveries without complications (PKMK UGM 2019). In 2016, this proportion was 20.4% or around USD 35.9 million was spent for normal deliveries occurring at the hospital level. However, JKN regulations stipulate that unless there is no available primary health facility equipped for normal delivery services in the area, all normal deliveries without complications should take place in the primary health care setting (Ministry of Health 2016). Some of these hospital-based normal deliveries might be referrals

from areas that did not have well-equipped primary health facilities but could also be due to incorrect referral or patients bypassing the referral system, which are practices that have been documented in previous studies assessing JKN implementation (Syah 2019; Hadju & Nursyamsi 2020; Nugraheni, Mubasyiroh & Hartono 2020). While the proportion of hospital reimbursement for normal deliveries is relatively small compared to the total JKN hospital reimbursement (ranging from 0.9-1.9% between 2014 and 2019), the absolute amount increased consistently from USD 26.9 million in 2014 to USD 64.2 million in 2019 (Figure 9.1). This implies a large number of normal deliveries still taking place at the secondary health care level and resulted in increased financial burden on the JKN. Normal delivery cases in a hospital setting are also more costly with average reimbursement rates of USD 172 per case in 2016 or more than triple the reimbursement for normal deliveries in a primary health care setting (USD 50 per case) (PKMK UGM 2019; Ministry of Health 2016).

It should be noted that there are variations in the current quality of services provided at different levels of health facilities and across different types of skilled birth attendants. Previous studies show that lower maternal mortality ratio (MMR) was associated with higher availability of doctors and shorter distance to hospitals, but not with the number of midwives nor distance to primary health centres (Cameron, Suarez & Cornwell 2019). Studies conducted in other LMICs have also concluded that lower-level facilities had less capacity to deliver quality maternal health services (Hanson et al. 2013; Kruk et al. 2014; Chaturvedi et al. 2014; Hanson et al. 2015). And thus, strengthening and ensuring that all basic services can be provided at the primary care level is important to improve JKN efficiency as well as the health outcomes of the population.

Figure 9. 1 JKN hospital reimbursement for normal deliveries, 2014-2019



Source: BPJS-Kesehatan sample data, analysed by the Center for Health Policy & Management, Universitas Gadjah Mada (2019).

The current implementation of the national health insurance program may also worsen existing socioeconomic inequalities in access to secondary health facilities for maternal delivery. The results in Manuscript 4 showed significant differences in the use of hospital as the place of delivery across wealth quintiles. Only 19.9% of women in the poorest quintile

delivered at a hospital compared to 58.4% of women in the richest quintile. Further, the effect of insurance coverage in increasing the probability of hospital-based delivery was larger by 30.4% for women in the richest quintile compared to the poorest. And thus, insurance coverage appears to increase the inequitable utilisation of high level and more expensive health services across the population.

To summarise, without focusing on strengthening primary health care, the expansion of health insurance appears to result in higher costs of care. Existing socioeconomic inequality might also worsen because the richer population, who already have better access to high-cost services, would gain the most benefit from the insurance coverage. Therefore, there is a need to first strengthen primary health care, improve the quality of the service and promote the use of primary health facilities for basic health services to reduce preferences for hospital-based services. This would also ensure that the segment of the population with limited access to hospitals, i.e. the poorest population and those living in less-developed regions, would still have access to quality health care services. Without a strong primary care system, insurance programs that operate under a two-tier system such as JKN, will not contribute effectively to attaining sustainable universal effective health coverage.

9. 4. Research arising from this thesis

Overall, the thesis underscores the importance of the health system on maternal and child health service coverage and outcomes. Future research could assess the interaction between supply-side factors and socioeconomic and geographical inequality using facility-based information. As mentioned in the Limitation section, the datasets used in this thesis did not have information on the readiness of the health facilities in areas where respondents lived. So, quality of care was captured using the patients' recall and perspective. Future research could use, for example, the DHS Service Provision Assessment (SPA) datasets and combine these with the household survey to assess the distributional pathways towards effective health coverage. Unfortunately, as of the writing of this thesis, there no available SPA survey on Indonesia.

Future study is also needed to further explore the implementation of the JKN from the providers' perspective to capture richer information relating to barriers to quality RMCH services. Such research could also enrich the understanding of what types of health service delivery models could work better in different regions across Indonesia.

Ongoing monitoring and evaluation of JKN are also important. Due to data availability, the thesis could only assess 3-years following JKN implementation. To improve the program, it would be pertinent to provide more evidence on JKN's impact in reducing health inequities. There is also a need to assess the impact of JKN on a wider range of mortality outcomes and not just on health service utilisation.

It would also be interesting to conduct implementation research that looks at possible different service delivery models within the context of JKN. This would have the potential to

tailor some of the policies relating to JKN implementation to address contextual differences in the health systems readiness across Indonesia.

It is important to recognise that the Indonesian government has made substantial investments in the health sector, evidence of the political will to improve the population health outcomes. The JKN program has played an important role in alleviating financial barriers and in improving access to key maternal and child health services. Resolving Indonesia's health systems challenges is particularly complex because of the large population distributed unequally across the world's largest archipelago, diversities in its geographical and political landscapes as well as persistent inequalities in the socioeconomic determinants of health and health systems readiness. And thus, future studies should take into account these challenges as the context in investigating possible interventions to improve the population health outcomes.

And finally, this thesis was finalised during the COVID-19 pandemic where studies have emerged showing the impact of the pandemic in disrupting access to essential health services including maternal and child health, HIV/AIDS, tuberculosis and malaria (Akseer et al. 2020; Bell et al. 2020; Jewell et al. 2020; Karim & Karim 2020). Further research is needed to learn the long-term impact of these disruptions to health services so that the global health community can prepare better for any future pandemic.

9. 5. Conclusion

Improving maternal and child health outcomes has been a growing global commitment, but challenges remained and within-country disparities in accessing quality health services have been one of the main hindrances in achieving universal effective health coverage. The work in this thesis contributes new evidence that could help inform policy decisions. According to the results presented, while the JKN program appears to increase the use of RMCH services, its implementation could be strengthened by focusing the health investments on equitable distribution of quality health care services. Policies that are contextualised to various settings in Indonesia and address the need for quality primary health care may contribute to attaining universal effective health coverage for the population.

References

- Ababor, S, Birhanu, Z, Defar, A, Amenu, K, Dibaba, A, Araraso, D, Gebreyohanes, Y & Hadis, M 2019, 'Socio-cultural Beliefs and Practices Influencing Institutional Delivery Service Utilization in Three Communities of Ethiopia: A Qualitative Study', *Ethiopian Journal of Health Sciences*, vol. 29, no. 3.
- Abbas, DF, Mirzazada, S, Durocher, J, Pamiri, S, Byrne, ME & Winikoff, B 2020, 'Testing a home-based model of care using misoprostol for prevention and treatment of postpartum hemorrhage: results from a randomized placebo-controlled trial conducted in Badakhshan province, Afghanistan', *Reproductive Health*, vol. 17, pp. 1–9.
- Achadi, E, Achadi, A, Pambudi, E & Marzoeki, P 2014, 'A study on the implementation of JAMPERSAL policy in Indonesia', *Washington, DC.: World Bank Group*.
- Achadi, EL, Achadi, A, Pambudi, E & Marzoeki, P 2014, 'A study on the implementation of JAMPERSAL policy in Indonesia', *Washington, DC.: World Bank Group*.
- Aday, LA & Andersen, R 1974, 'A framework for the study of access to medical care', *Health services research*, vol. 9, no. 3, p. 208.
- Adegbosin, AE, Zhou, H, Wang, S, Stantic, B & Sun, J 2019, 'Systematic review and meta-analysis of the association between dimensions of inequality and a selection of indicators of Reproductive, Maternal, Newborn and Child Health (RMNCH)', *Journal of global health*, vol. 9, no. 1.
- Adhikari, R 2016, 'Effect of Women's autonomy on maternal health service utilization in Nepal: a cross sectional study', *BMC Women's Health*, vol. 16, no. 1, p. 26.
- Afifah, T, Tejayanti, T, Saptarini, I, Rizkianti, A, Usman, Y, Senewe, FP & Pangaribuan, L 2016, 'Maternal death in Indonesia: follow-up study of the 2010 Indonesia population census', *Jurnal Kesehatan Reproduksi*, vol. 7, no. 1, pp. 1–13.
- Afsana, K & Rashid, SF 2001, 'The challenges of meeting rural Bangladeshi women's needs in delivery care', *Reproductive Health Matters*, vol. 9, no. 18, pp. 79–89.
- Agborsangaya, CB, Lau, D, Lahtinen, M, Cooke, T & Johnson, JA 2012, 'Multimorbidity prevalence and patterns across socioeconomic determinants: a cross-sectional survey', *BMC public health*, vol. 12, no. 1, p. 201.
- Aggarwal, A 2010, 'Impact evaluation of India's 'Yeshasvini' community-based health insurance programme', *Health economics*, vol. 19, no. S1, pp. 5–35.

- Agogbuo, M, Akpovi, S, Achime, N & Bello, S 2011, 'SP3-36 Utilisation of maternal health services among women of reproductive age group in a rural district, southern Nigeria', *Journal of Epidemiology & Community Health*, vol. 65, no. Suppl 1, pp. A418–A418.
- Agus, Y, Horiuchi, S & Iida, M 2018, 'Women's choice of maternal healthcare in Parung, West Java, Indonesia: Midwife versus traditional birth attendant', *Women and Birth*, vol. 31, no. 6, pp. 513–519.
- Agustina, R, Dartanto, T, Sitompul, R, Susiloretni, KA, Achadi, EL, Taher, A, Wirawan, F, Sungkar, S, Sudarmono, P & Shankar, AH 2018, 'Universal health coverage in Indonesia: concept, progress, and challenges', *The Lancet*.
- Ahmed, S, Bardhan, PK, Iqbal, A, Mazumder, RN, Khan, AI, Islam, MS, Siddique, AK & Cravioto, A 2011, 'The 2008 cholera epidemic in Zimbabwe: experience of the icddr, b team in the field', *Journal of health, population, and nutrition*, vol. 29, no. 5, p. 541.
- Aji, B, De Allegri, M, Souares, A & Sauerborn, R 2013, 'The impact of health insurance programs on out-of-pocket expenditures in Indonesia: an increase or a decrease?', *International journal of environmental research and public health*, vol. 10, no. 7, pp. 2995–3013.
- Akker, T van den, Nair, M, Goedhart, M, Schutte, J, Schaap, T & Knight, M 2017, 'Maternal mortality: direct or indirect has become irrelevant', *The Lancet Global Health*, vol. 5, no. 12, pp. e1181–e1182.
- Akseer, N, Kandru, G, Keats, EC & Bhutta, ZA 2020, 'COVID-19 pandemic and mitigation strategies: implications for maternal and child health and nutrition', *The American journal of clinical nutrition*, vol. 112, no. 2, pp. 251–256.
- Alam, N, Hajizadeh, M, Dumont, A & Fournier, P 2015, 'Inequalities in maternal health care utilization in sub-Saharan African countries: a multiyear and multi-country analysis', *PloS One*, vol. 10, no. 4, p. e0120922.
- Ali, M, Asefaw, T, Byass, P, Beyene, H & Pedersen, FK 2005, 'Helping northern Ethiopian communities reduce childhood mortality: population-based intervention trial', *Bulletin of the World Health Organization*, vol. 83, pp. 27–33.
- Alkema, L, Chou, D, Hogan, D, Zhang, S, Moller, A, Gemmill, A, Fat, D, Boerma, T, Temmerman, M, Mathers, C & Say, L 2016, 'Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group', *The Lancet*, vol. 387, no. 10017, pp. 462–474.

- Alvarez, M & Barranquero, A 2009, 'Inequalities in health care utilization in Spain due to double insurance coverage: An Oaxaca-Ransom decomposition', *Social Science & Medicine*, vol. 69, no. 5, pp. 793–801.
- Amaghionyeodiwe, LA 2008, 'Determinants of the choice of health care provider in Nigeria', *Health care management science*, vol. 11, no. 3, pp. 215–227.
- Amouzou, A, Leslie, HH, Ram, M, Fox, M, Jiwani, SS, Requejo, J, Marchant, T, Munos, MK, Vaz, LM & Weiss, W 2019, 'Advances in the measurement of coverage for RMNCH and nutrition: from contact to effective coverage', *BMJ global health*, vol. 4, no. Suppl 4, p. e001297.
- Amporfufu, E & Grépin, KA 2019, 'Measuring and explaining changing patterns of inequality in institutional deliveries between urban and rural women in Ghana: a decomposition analysis', *International Journal for Equity in Health*, vol. 18, no. 1, p. 123.
- Ananta, A, Arifin, E, Hasbullah, M, Handayani, N & Pramono, A 2013, 'Changing ethnic composition: Indonesia, 2000–2010.', in IUSSP International Population Conference, Busan, Republic of Korea.
- Andersen, RM 1995, 'Revisiting the behavioral model and access to medical care: does it matter?', *Journal of Health and Social Behavior*, pp. 1–10.
- Anderson, I, Meliala, A, Marzoeqi, P & Pambudi, E 2014, 'The production, distribution, and performance of physicians, nurses, and midwives in Indonesia: an update', *The World Bank*, pp. 1–56.
- Andriani, H, Liao, C-Y & Kuo, H-W 2016, 'Association of maternal and child health center (Posyandu) availability with child weight status in Indonesia: a national study', *International journal of environmental research and public health*, vol. 13, no. 3, p. 293.
- Anindya, K, Lee, JT, McPake, B, Wilopo, SA & Carvalho, N 2020, 'The impact of Indonesia's national health insurance scheme on inequality in access to maternal health services: a propensity score matched analysis', , vol. 10, no. 1.
- Anindya, K, Lee, JT, McPake, B, Wilopo, SA, Millett, C & Carvalho, N 2020, 'Impact of Indonesia's national health insurance scheme on inequality in access to maternal health services: A propensity score matched analysis', *Journal of Global Health*, vol. 10, no. 1, accessed August 26, 2020, from <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7298736/>>.

- Antina, RR 2016, 'Analisis kualitas pelayanan terhadap kepuasan pasien peserta BPJS di Puskesmas Pandian Kabupaten Sumenep', *JPAP: Jurnal Penelitian Administrasi Publik*, vol. 2, no. 02.
- Anwar, F, Khomsan, A, Sukandar, D, Riyadi, H & Mudjajanto, ES 2010, 'High participation in the Posyandu nutrition program improved children nutritional status', *Nutrition research and practice*, vol. 4, no. 3, pp. 208–214.
- Argaw, D, Fanthahun, M & Berhane, Y 2007, 'Sustainability and factors affecting the success of community-based reproductive health programs in rural Northwest Ethiopia', *African journal of reproductive health*, pp. 79–88.
- Asamoah, B, Agardh, A & Cromley, E 2014, 'Spatial analysis of skilled birth attendant utilization in Ghana', *Global Journal of Health Science*, vol. 6, no. 4, pp. 117–27.
- Ashish, K, Singh, DR, Upadhyaya, MK, Budhathoki, SS, Gurung, A & Målqvist, M 2020, 'Quality of care for maternal and newborn health in health facilities in Nepal', *Maternal and Child Health Journal*, vol. 24, no. 1, pp. 31–38.
- Assarag, B, Dujardin, B, Delamou, A, Meski, F-Z & De Brouwere, V 2015, 'Determinants of maternal near-miss in Morocco: too late, too far, too sloppy?', *PloS one*, vol. 10, no. 1, p. e0116675.
- Atuoye, KN, Dixon, J, Rishworth, A, Galaa, SZ, Boamah, SA & Luginaah, I 2015, 'Can she make it? Transportation barriers to accessing maternal and child health care services in rural Ghana', *BMC health services research*, vol. 15, no. 1, p. 333.
- Bailey, P, Lobis, S, Maine, D & Fortney, JA 2009, *Monitoring emergency obstetric care: a handbook*, World Health Organization.
- Balarajan, Y, Selvaraj, S & Subramanian, S 2011, 'Health care and equity in India', *The Lancet*, vol. 377, no. 9764, pp. 505–515.
- Bappeda Provinsi Jawa Timur 2012, '12 Ribu Perawat Masih Menganggur', accessed July 15, 2020, from <<http://bappeda.jatimprov.go.id/2012/05/28/12-%20%20%20%20%20%20%20%20%20ribu-perawat-masih-menganggur/>>.
- Baqui, AH, Mitra, DK, Begum, N, Hurt, L, Soremekun, S, Edmond, K, Kirkwood, B, Bhandari, N, Taneja, S & Mazumder, S 2016, 'Neonatal mortality within 24 hours of birth in six low-and lower-middle-income countries', *Bulletin of the World Health Organization*, vol. 94, no. 10, p. 752.
- Barros, AJ, Ronsmans, C, Axelson, H, Loaiza, E, Bertoldi, AD, França, GV, Bryce, J, Boerma, JT & Victora, CG 2012, 'Equity in maternal, newborn, and child health interventions in

- Countdown to 2015: a retrospective review of survey data from 54 countries', *The Lancet*, vol. 379, no. 9822, pp. 1225–1233.
- Barros, AJ & Victora, CG 2013, 'Measuring coverage in MNCH: determining and interpreting inequalities in coverage of maternal, newborn, and child health interventions', *PLoS Medicine*, vol. 10, no. 5, accessed September 21, 2020, from <<https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1001390>>.
- Barros, FC, Matijasevich, A, Requejo, JH, Giugliani, E, Maranhão, AG, Monteiro, CA, Barros, AJD, Bustreo, F, Merialdi, M & Victora, CG 2010, 'Recent Trends in Maternal, Newborn, and Child Health in Brazil: Progress Toward Millennium Development Goals 4 and 5', *American Journal of Public Health*, vol. 100, no. 10, pp. 1877–1889.
- Barros, FC, Victora, CG, Barros, AJ, Santos, IS, Albernaz, E, Matijasevich, A, Domingues, MR, Sclowitz, IK, Hallal, PC, Silveira, MF & Vaughan, JP 2005, 'The challenge of reducing neonatal mortality in middle-income countries: findings from three Brazilian birth cohorts in 1982, 1993, and 2004', *The Lancet*, vol. 365, no. 9462, pp. 847–854.
- Bauer, TK & Sinning, M 2008, 'An extension of the Blinder–Oaxaca decomposition to nonlinear models', *AStA Advances in Statistical Analysis*, vol. 92, no. 2, pp. 197–206.
- Bell, D, Hansen, KS, Kiragga, AN, Kambugu, A, Kissa, J & Mbonye, AK 2020, 'Predicting the impact of COVID-19 and the potential impact of the public health response on disease burden in Uganda', *The American Journal of Tropical Medicine and Hygiene*, vol. 103, no. 3, pp. 1191–1197.
- Benirschke, K, Burton, GJ & Baergen, RN 2012, 'Maternal diseases complicating pregnancy: diabetes, tumors, preeclampsia, lupus anticoagulant', in *Pathology of the human placenta*, Springer, pp. 495–555.
- Bennett, LR 2017, 'Indigenous healing knowledge and infertility in Indonesia: Learning about cultural safety from Sasak midwives', *Medical Anthropology*, vol. 36, no. 2, pp. 111–124.
- Bergström, S 2015, 'Training non-physician mid-level providers of care (associate clinicians) to perform caesarean sections in low-income countries', *Best practice & research Clinical obstetrics & gynaecology*, vol. 29, no. 8, pp. 1092–1101.
- Bernal, JL, Cummins, S & Gasparrini, A 2017, 'Interrupted time series regression for the evaluation of public health interventions: a tutorial', *International journal of epidemiology*, vol. 46, no. 1, pp. 348–355.
- Bertoldi, AD, Barros, FC, Hallal, PRC, Mielke, GI, Oliveira, PD, Maia, MFS, Horta, BL, Gonçalves, H, Barros, AJD, Tovo-Rodrigues, L, Murray, J & Victora, CG 2019, 'Trends

- and inequalities in maternal and child health in a Brazilian city: methodology and sociodemographic description of four population-based birth cohort studies, 1982–2015', *International Journal of Epidemiology*, vol. 48, no. Supplement_1, pp. i4–i15.
- Betran, A, Torloni, M, Zhang, J & Gülmezoglu, A 2015, 'WHO Statement on caesarean section rates', *BJOG: An International Journal of Obstetrics & Gynaecology*.
- Bhutta, ZA, Chopra, M, Axelson, H, Berman, P, Boerma, T, Bryce, J, Bustreo, F, Cavagnero, E, Cometto, G & Daelmans, B 2010, 'Countdown to 2015 decade report (2000–10): taking stock of maternal, newborn, and child survival', *The Lancet*, vol. 375, no. 9730, pp. 2032–2044.
- Bhutta, ZA, Das, JK, Bahl, R, Lawn, JE, Salam, RA, Paul, VK, Sankar, MJ, Blencowe, H, Rizvi, A & Chou, VB 2014, 'Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost?', *The Lancet*, vol. 384, no. 9940, pp. 347–370.
- Bhutta, ZA, Das, JK, Rizvi, A, Gaffey, MF, Walker, N, Horton, S, Webb, P, Lartey, A, Black, RE & Group, TLNIR 2013, 'Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost?', *The Lancet*, vol. 382, no. 9890, pp. 452–477.
- Black, RE, Cousens, S, Johnson, HL, Lawn, JE, Rudan, I, Bassani, DG, Jha, P, Campbell, H, Walker, CF & Cibulskis, R 2010, 'Global, regional, and national causes of child mortality in 2008: a systematic analysis', *The lancet*, vol. 375, no. 9730, pp. 1969–1987.
- Blanc, AK, Diaz, C, McCarthy, KJ & Berdichevsky, K 2016, 'Measuring progress in maternal and newborn health care in Mexico: validating indicators of health system contact and quality of care', *BMC pregnancy and childbirth*, vol. 16, no. 1, pp. 1–11.
- Blanc, AK, Warren, C, McCarthy, KJ, Kimani, J, Ndwiga, C & RamaRao, S 2016, 'Assessing the validity of indicators of the quality of maternal and newborn health care in Kenya', *Journal of global health*, vol. 6, no. 1.
- Blencowe, H, Lawn, J, Vandelaer, J, Roper, M & Cousens, S 2010, 'Tetanus toxoid immunization to reduce mortality from neonatal tetanus', *International journal of epidemiology*, vol. 39, no. suppl_1, pp. i102–i109.
- Blinder, AS 1973, 'Wage discrimination: reduced form and structural estimates', *Journal of Human Resources*, pp. 436–455.

- Bloom, SS, Wypij, D & Gupta, MD 2001, 'Dimensions of women's autonomy and the influence on maternal health care utilization in a north Indian city', *Demography*, vol. 38, no. 1, pp. 67–78.
- Blum, J, Raghavan, S, Dabash, R, Chelli, H, Hajri, S, Conkling, K & Winikoff, B 2012, 'Comparison of misoprostol-only and combined mifepristone–misoprostol regimens for home-based early medical abortion in Tunisia and Vietnam', *International Journal of Gynecology & Obstetrics*, vol. 118, no. 2, pp. 166–171.
- Boachie, MK 2015, 'Preferred Primary Healthcare Provider Choice Among Insured Persons in Ashanti Region, Ghana', *International Journal of Health Policy and Management*, vol. 5, no. 3, pp. 155–163.
- Boerma, T, Requejo, J, Victora, C, Amouzou, A, George, A, Agyepong, I, Barroso, C, Barros, A, Bhutta, Z & Black, R 2018, 'Countdown to 2030: tracking progress towards universal coverage for reproductive, maternal, newborn, and child health', *The Lancet*, vol. 391, no. 10129, pp. 1538–1548.
- Bonfrer, I, Van de Poel, E, Grimm, M & Van Doorslaer, E 2014, 'Does the distribution of healthcare utilization match needs in Africa?', *Health Policy and Planning*, vol. 29, no. 7, pp. 921–937.
- Bose, M 2019, 'Determinants of Choice of Care Providers During Childbirth in Rural West Bengal, India', *Indian Journal of Human Development*, vol. 13, no. 1, pp. 47–70.
- BPJS Kesehatan 2018, *Laporan Keuangan BPJS Kesehatan 2014-2017 (Auditan)*, BPJS Kesehatan, Jakarta.
- BPJS Kesehatan 2020a, 'Peserta program JKN', accessed August 31, 2020, from <<https://www.bpjs-kesehatan.go.id/bpjs/home>>.
- BPJS Kesehatan 2020b, 'JKN coverage', accessed October 1, 2020, from <<https://bpjs-kesehatan.go.id/bpjs/>>.
- BPJS Kesehatan 2020c, *BPJS-Kesehatan financial report*, BPJS Kesehatan, Jakarta, Indonesia, accessed September 25, 2020, from <<https://bpjs-kesehatan.go.id/bpjs/arsip/detail/1520>>.
- Brooks, MI, Thabrany, H, Fox, MP, Wirtz, VJ, Feeley, FG & Sabin, LL 2017, 'Health facility and skilled birth deliveries among poor women with Jamkesmas health insurance in Indonesia: a mixed-methods study', *BMC Health Services Research*, vol. 17, no. 1, p. 105.

- Bureau of Statistics Indonesia, National Population and Family Planning Board (BKKBN), Ministry of Health Indonesia & ICF International 2013, *Indonesia Demographic and Health Survey 2012*, BPS, BKKBN, Kemenkes, and ICF International, Jakarta, Indonesia, accessed from <<https://dhsprogram.com/pubs/pdf/FR275/FR275.pdf>>.
- Byamugisha, R, Tumwine, JK, Semiyaga, N & Tylleskär, T 2010, 'Determinants of male involvement in the prevention of mother-to-child transmission of HIV programme in Eastern Uganda: a cross-sectional survey', *Reproductive Health*, vol. 7, no. 1, p. 12.
- Byrne, A, Hodge, A, Jimenez-Soto, E & Morgan, A 2014, 'What works? Strategies to increase reproductive, maternal and child health in difficult to access mountainous locations: a systematic literature review', *PloS one*, vol. 9, no. 2, p. e87683.
- Cameron, L, Contreras Suarez, D & Cornwell, K 2019, 'Understanding the determinants of maternal mortality: An observational study using the Indonesian Population Census', *PloS one*, vol. 14, no. 6, p. e0217386.
- Cameron, L, Suarez, DC & Cornwell, K 2019, 'Understanding the determinants of maternal mortality: An observational study using the Indonesian Population Census', *PLOS ONE*, vol. 14, no. 6, p. e0217386.
- Carvalho, N & Rokicki, S 2019, 'The impact of India's Janani Suraksha Yojana conditional cash transfer programme: A replication study', *The Journal of Development Studies*, vol. 55, no. 5, pp. 989–1006.
- Carvalho, N, Salehi, AS & Goldie, SJ 2013, 'National and sub-national analysis of the health benefits and cost-effectiveness of strategies to reduce maternal mortality in Afghanistan', *Health Policy and Planning*, vol. 28, no. 1, pp. 62–74.
- Cassels, A 1995, 'Health sector reform: key issues in less developed countries', *Journal of International development*, vol. 7, no. 3, pp. 329–347.
- Cavallaro, FL, Benova, L, Wong, K, Sheppard, P, Faye, A, Radovich, E, Dumont, A, Mbengue, AS, Ronsmans, C & Martinez-Alvarez, M 2020, 'What the percentage of births in facilities does not measure: readiness for emergency obstetric care and referral in Senegal', *BMJ global health*, vol. 5, no. 3, p. e001915.
- Central Bureau of Statistics 2011, *Penduduk Menurut Wilayah dan Agama yang Dianut Sensus Penduduk 2010 [Population by region and religion. 2010 census]*, Central Bureau of Statistics, Jakarta.
- Central Bureau of Statistics 2016, 'Maternal mortality ratio by island group', accessed October 21, 2020, from <https://www.bps.go.id/indikator/indikator/view_data/0000/data/1349/sdgs_3/1>.

Central Bureau of Statistics 2018a, 'Angka kematian bayi menurut provinsi (infant mortality rate by province)', accessed September 20, 2020, from <<https://www.bps.go.id/dynamictable/2019/10/06/1688/angka-kematian-bayi-akb-per-1000-kelahiran-hidup-menurut-provinsi-2012-dan-2017.html>>.

Central Bureau of Statistics 2018b, *Projected Indonesian population based on 2015 population intercensus*, Central Bureau of Statistics, Jakarta, accessed September 13, 2020, from <<https://databoks.katadata.co.id/datapublish/2020/01/02/inilah-proyeksi-jumlah-penduduk-indonesia-2020>>.

Central Bureau of Statistics 2019a, *Statistik Indonesia: statistical yearbook of Indonesia 2019*, Indonesia Central Bureau of Statistics, Jakarta, accessed September 13, 2020, from <<https://www.bps.go.id/publication/download.html?nrbvfeve=ZGFhYzFiYTE4Y2FIMWU5MDcwNmVINThh&xzmn=aHR0cHM6Ly93d3cuYnBzLmdvLmIkL3B1YmxpY2F0aW9uLzlwMTkvMDcvMDQvZGFhYzFiYTE4Y2FIMWU5MDcwNmVINThhL3N0YXRpc3Rpay1pbmRvbmVzaWEtMjAxOS5odG1s&twordfnoarfeauf=MjAyMC0wOS0xMyAwOT00TozMw%3D%3D>>.

Central Bureau of Statistics 2019b, *Statistik Kesejahteraan Rakyat 2018*, Central Bureau of Statistics, Jakarta, Indonesia, accessed April 29, 2021, from <<https://www.bps.go.id/publication/2018/11/26/81ede2d56698c07d510f6983/statistik-kesejahteraan-rakyat-2018.html>>.

Central Bureau of Statistics Indonesia, Indonesia and State Ministry of Population, National Family Planning Coordinating Board, Indonesia and Ministry of Health & Macro International 1992, *Indonesia Demographic and Health Survey 1991*, accessed February 5, 2020, from <<https://dhsprogram.com/publications/publication-fr18-dhs-final-reports.cfm>>.

Central Bureau of Statistics Indonesia, National Population and Family Planning Board (BKKBN) & Calverton, OM 2003, *Indonesia demographic and health survey 2002-2003*, Central Bureau of Statistics, National Family Planning Coordinating Board, ORC Macro Calverton, Jakarta.

Central Bureau of Statistics, National Family Planning Coordinating Board (BKKBN) & Inc., MI 1992, *Indonesia demographic and health survey 1991*, Central Bureau of Statistics, National Family Planning Coordinating Board Jakarta, Macro International Inc., Jakarta.

Central Bureau of Statistics, National Family Planning Coordinating Board (BKKBN) & Inc., MI 2008, *Indonesia demographic and health survey 2007*, Central Bureau of Statistics,

National Family Planning Coordinating Board, Macro International Calverton, Jakarta.

- Chalasani, S 2012, 'Understanding wealth-based inequalities in child health in India: a decomposition approach', *Social Science & Medicine*, vol. 75, no. 12, pp. 2160–2169.
- Channon, AA, Neal, S, Matthews, Z & Falkingham, J 2013, *Maternal health inequalities over time: is there a common pathway? background paper for "addressing inequalities the heart of the post-2015 development agenda and the future we want for all global thematic consultation"* – *ScienceOpen*, accessed October 8, 2020, from <<https://www.scienceopen.com/document?vid=9482e839-31c8-4781-b456-c6ea72f50174>>.
- Chattopadhyay, A 2012, 'Men in maternal care: Evidence from India', *Journal of Biosocial Science*, vol. 44, no. 2, pp. 129–153.
- Chaturvedi, S, Randive, B, Diwan, V & De Costa, A 2014, 'Quality of obstetric referral services in India's JSY cash transfer programme for institutional births: a study from Madhya Pradesh province', *PloS one*, vol. 9, no. 5, p. e96773.
- Chemlal, S & Russo, G 2019, 'Why do they take the risk? A systematic review of the qualitative literature on informal sector abortions in settings where abortion is legal', *BMC women's health*, vol. 19, no. 1, pp. 1–11.
- Chisti, M, Salam, M, Ahmed, T, Shahid, A, Shahunja, K, Faruque, A, Bardhan, P, Hossain, M, Islam, M & Das, S 2015, 'Lack of BCG vaccination and other risk factors for bacteraemia in severely malnourished children with pneumonia', *Epidemiology & Infection*, vol. 143, no. 4, pp. 799–803.
- Chola, L, McGee, S, Tugendhaft, A, Buchmann, E & Hofman, K 2015, 'Scaling up family planning to reduce maternal and child mortality: the potential costs and benefits of modern contraceptive use in South Africa', *PLoS One*, vol. 10, no. 6, p. e0130077.
- Chu, K, Rosseel, P, Gielis, P & Ford, N 2009, 'Surgical task shifting in sub-Saharan Africa', *PLoS medicine*, vol. 6, no. 5.
- Claeson, M, Griffin, C, Johnston, TA, McLachlan, M, Soucat, A, Wagstaff, A & Yazbeck, A 2001, 'Health, nutrition and population', in *Poverty reduction strategy sourcebook*, World Bank, Washington DC, accessed July 15, 2020, from <https://d1wqtxts1xzle7.cloudfront.net/42656824/hnp.pdf?1455402221=&response-content-disposition=inline%3B+filename%3DChapter_18_Health_Nutrition_and_Populati.pdf&Expires=1600747944&Signature=OTYdI4AaF1qHwC2x5m~pdJ41c~xumKMck8l6~snF~S110a5mf->

mWoAsBgD3jMMrOjueqIUmYAHPMxFalQfqkk2BXGkciv4TdhtKDSE~CZHDpR2F4j91lx
 euwzPi2kM-I5e4Ps3-NOjhuV3mVxceUpD16CqXYW3M39R-1lqWTUxqbV87gay4wXR-
 bnB0H0cJ5YI5N9BcNpxYL4dw-5GXRrbhU5g~hga2iq-
 z8oOkYmMPCOdFqoVXOZPDP44PRIs2SVXtQRQFNIP45II0oO2C-
 mLe1nzXa5zjDzD3l8ZdqnBhDSjtFd-0yf9Dh8DOKWoI7o3AQnTxV2X~fk9GZfl-
 g__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA>.

- Collin, SM, Anwar, I & Ronsmans, C 2007, 'A decade of inequality in maternity care: antenatal care, professional attendance at delivery, and caesarean section in Bangladesh (1991–2004)', *International journal for Equity in Health*, vol. 6, no. 1, p. 9.
- Comfort, AB, Peterson, LA & Hatt, LE 2013, 'Effect of health insurance on the use and provision of maternal health services and maternal and neonatal health outcomes: a systematic review', *Journal of health, population, and nutrition*, vol. 31, no. 4 Suppl 2, p. S81.
- Compaoré, GD, Sombié, I, Ganaba, R, Hounton, S, Meda, N, De Brouwere, V & Borchert, M 2014, 'Readiness of district and regional hospitals in Burkina Faso to provide caesarean section and blood transfusion services: a cross-sectional study', *BMC pregnancy and childbirth*, vol. 14, no. 1, p. 158.
- Conlon, CM, Serbanescu, F, Marum, L, Healey, J, LaBrecque, J, Hobson, R, Levitt, M, Kekitiinwa, A, Picho, B & Soud, F 2019, 'Saving Mothers, Giving Life: it takes a system to save a mother', *Global Health: Science and Practice*, vol. 7, no. Supplement 1, pp. S6–S26.
- Countdown to Collaboration 2018, 'Countdown to 2030: tracking progress towards universal coverage for reproductive, maternal, newborn, and child health', *The Lancet*.
- D'Ambruoso, L 2012, 'Relating the construction and maintenance of maternal ill-health in rural Indonesia', *Global Health Action*, vol. 5, no. 1, p. 17989.
- Dari, AT, Zulfendri & Aulia, D 2019, 'Association between socialization and the use of maternity waitin ghome in East Aceh, Indonesia', *Journal of Health Policy and Management*, vol. 4, no. 2, pp. 86–90.
- Darmstadt, G, Bhutta, Z, Cousens, S, Adam, T, Walker, N, De Bernis, L & Lancet Neonatal Survival Steering team 2005, 'Evidence-based, cost-effective interventions: how many newborn babies can we save?', *The Lancet*, vol. 365, no. 9463, pp. 977–988.
- David, E, Machungo, F, Zanconato, G, Cavaliere, E, Fiosse, S, Sululu, C, Chiluvane, B & Bergström, S 2014, 'Maternal near miss and maternal deaths in Mozambique: a

- cross-sectional, region-wide study of 635 consecutive cases assisted in health facilities of Maputo province', *BMC Pregnancy and Childbirth*, vol. 14, no. 1, p. 401.
- Dawson, AJ, Buchan, J, Duffield, C, Homer, CS & Wijewardena, K 2014, 'Task shifting and sharing in maternal and reproductive health in low-income countries: a narrative synthesis of current evidence', *Health policy and planning*, vol. 29, no. 3, pp. 396–408.
- Dawson, P, Pradhan, YV, Houston, R, Karki, S, Poudel, D & Hodgins, S 2008, 'From research to national expansion: 20 years' experience of community-based management of childhood pneumonia in Nepal', *Bulletin of the World Health Organization*, vol. 86, pp. 339–343.
- De Allegri, M, Ridde, V, Louis, VR, Sarker, M, Tiendrebéogo, J, Yé, M, Müller, O & Jahn, A 2011, 'Determinants of utilisation of maternal care services after the reduction of user fees: a case study from rural Burkina Faso', *Health policy*, vol. 99, no. 3, pp. 210–218.
- Deaton, A 1997, *The analysis of household surveys: a microeconomic approach to development policy*, The World Bank.
- DHS Program 2018, *DHS Model Questionnaire - Phase 7*, DHS Program, accessed September 22, 2020, from <<https://dhsprogram.com/publications/publication-dhsq7-dhs-questionnaires-and-manuals.cfm>>.
- Donabedian, A 1988, 'The quality of care: How can it be assessed?', *JAMA*, vol. 260, no. 12, pp. 1743–1748.
- Donabedian, A 2005, 'Evaluating the Quality of Medical Care', *The Milbank Quarterly*, vol. 83, no. 4, pp. 691–729.
- Douthwaite, M & Ward, P 2005, 'Increasing contraceptive use in rural Pakistan: an evaluation of the Lady Health Worker Programme', *Health policy and planning*, vol. 20, no. 2, pp. 117–123.
- Dummer, TJ 2008, 'Health geography: supporting public health policy and planning', *Cmaj*, vol. 178, no. 9, pp. 1177–1180.
- Efendi, F, Ni'mah, AR, Hadisuyatmana, S, Kuswanto, H, Lindayani, L & Berliana, SM 2019, 'Determinants of facility-based childbirth in Indonesia', *The Scientific World Journal*, vol. 2019.
- Engin-Üstün, Y, Sanisoğlu, S, Keskin, HL, Karaahmetoğlu, S, Özcan, A, Çelen, Ş, Üstün, Y, Alkan, A, Ongun, V & Şencan, İ 2019, 'Changing trends in the Turkish maternal

- deaths, with a focus on direct and indirect causes', *European Journal of Obstetrics & Gynecology and Reproductive Biology*, vol. 234, pp. 21–25.
- Ensor, T, Nadjib, M, Quayyum, Z & Megraini, A 2008, 'Public funding for community-based skilled delivery care in Indonesia: to what extent are the poor benefiting?', *The European Journal of Health Economics*, vol. 9, no. 4, pp. 385–392.
- Ergo, A, Eichler, R, Koblinsky, M & Shah, N 2011, 'Strengthening health systems to improve maternal, neonatal and child health outcomes: a framework', *Washington, DC: MCHIP, USAID*.
- Ergo, A, Shahi, N, Rashidi, T & Rozario, A 2010, 'Malawi Case Study',.
- Erlangga, D, Ali, S & Bloor, K 2019, 'The impact of public health insurance on healthcare utilisation in Indonesia: evidence from panel data', *International Journal of Public Health*, vol. 64, no. 4, pp. 603–613.
- Erlyana, E, Damrongplasit, KK & Melnick, G 2011, 'Expanding health insurance to increase health care utilization: Will it have different effects in rural vs. urban areas?', *Health Policy*, vol. 100, no. 2, pp. 273–281.
- Erreygers, G 2009, 'Correcting the concentration index', *Journal of health economics*, vol. 28, no. 2, pp. 504–515.
- Evans, DB 2003, *Health systems performance assessment: debates, methods and empiricism*, World Health Organization.
- Evans, RG 1981, 'Incomplete vertical integration: the distinctive structure of the healthcare industry', *Health, economics, and health economics. Amsterdam: North Holland*, p. 44.
- Fadel, SA, Rasaily, R, Awasthi, S, Begum, R, Black, RE, Gelband, H, Gerland, P, Kumar, R, Liu, L & Mathers, C 2017, 'Changes in cause-specific neonatal and 1–59-month child mortality in India from 2000 to 2015: a nationally representative survey', *The Lancet*, vol. 390, no. 10106, pp. 1972–1980.
- Fairlie, RW 1999, 'The absence of the African-American owned business: An analysis of the dynamics of self-employment', *Journal of Labor Economics*, vol. 17, no. 1, pp. 80–108.
- Fairlie, RW 2005, 'An extension of the Blinder-Oaxaca decomposition technique to logit and probit models', *Journal of Economic and Social Measurement*, vol. 30, no. 4, pp. 305–316.

- Falkingham, J 2003, 'Inequality and changes in women's use of maternal Health-care services in Tajikistan', *Studies in Family Planning*, vol. 34, no. 1, pp. 32–43.
- Fang, P, Dong, S, Xiao, J, Liu, C, Feng, X & Wang, Y 2010, 'Regional inequality in health and its determinants: evidence from China', *Health Policy*, vol. 94, no. 1, pp. 14–25.
- Filippi, V, Ronsmans, C, Campbell, OM, Graham, WJ, Mills, A, Borghi, J, Koblinsky, M & Osrin, D 2006, 'Maternal health in poor countries: the broader context and a call for action', *The Lancet*, vol. 368, no. 9546, pp. 1535–1541.
- Filmer, D & Pritchett, LH 2001, 'Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India', *Demography*, vol. 38, no. 1, pp. 115–32.
- Filmer, D & Scott, K 2008, *Assessing asset indices*, The World Bank.
- Fort, MP, Grembowski, DE, Verdugo, JC, Morales, LC, Arriaga, CA, Mercer, MA & Lim, SS 2011, 'Implementation and progress of an inclusive primary health care model in Guatemala: coverage, quality, and utilization', *Revista Panamericana de Salud Pública*, vol. 30, pp. 217–224.
- Frankenberg, E, Buttenheim, A, Sikoki, B & Suriastini, W 2009, 'Do women increase their use of reproductive health care when it becomes more available? Evidence from Indonesia', *Studies in Family Planning*, vol. 40, no. 1, pp. 27–38.
- Frankenberg, E, Suriastini, W & Thomas, D 2005, 'Can expanding access to basic healthcare improve children's health status? Lessons from Indonesia's 'midwife in the village' programme', *Population Studies*, vol. 59, no. 1, pp. 5–19.
- Frenk, J 1994, 'Dimensions of health system reform', *Health policy*, vol. 27, no. 1, pp. 19–34.
- Fryatt, RJ & Bhuwanee, K 2017, 'Financing health systems to achieve the health Sustainable Development Goals', *The Lancet Global Health*, vol. 5, no. 9, pp. e841–e842.
- Furuta, M & Salway, S 2006, 'Women's position within the household as a determinant of maternal health care use in Nepal', *International family planning perspectives*, pp. 17–27.
- Gakidou, E, Lozano, R, González-Pier, E, Abbott-Klafter, J, Barofsky, JT, Bryson-Cahn, C, Feehan, DM, Lee, DK, Hernández-Llamas, H & Murray, CJ 2006, 'Assessing the effect of the 2001–06 Mexican health reform: an interim report card', *The Lancet*, vol. 368, no. 9550, pp. 1920–1935.

- Galactionova, K, Tediosi, F, Savigny, D de, Smith, T & Tanner, M 2015, 'Effective Coverage and Systems Effectiveness for Malaria Case Management in Sub-Saharan African Countries', *PLOS ONE*, vol. 10, no. 5, p. e0127818.
- Ganatra, B & Faundes, A 2016, 'Role of birth spacing, family planning services, safe abortion services and post-abortion care in reducing maternal mortality', *Best Practice & Research Clinical Obstetrics & Gynaecology*, vol. 36, pp. 145–155.
- Ganle, JK & Dery, I 2015, "'What men don't know can hurt women's health": a qualitative study of the barriers to and opportunities for men's involvement in maternal healthcare in Ghana', *Reproductive Health*, vol. 12, no. 1, p. 93.
- Geefhuysen, J 1999, 'Safe motherhood in Indonesia: a task for the next century',.
- Gerdts, C, Vohra, D & Ahern, J 2013, 'Measuring unsafe abortion-related mortality: a systematic review of the existing methods', *PloS one*, vol. 8, no. 1, p. e53346.
- Gibbons, L, Belizán, JM, Lauer, JA, Betrán, AP, Merialdi, M & Althabe, F 2010, 'The global numbers and costs of additionally needed and unnecessary caesarean sections performed per year: overuse as a barrier to universal coverage', *World health report*, vol. 30, no. 1, pp. 1–31.
- Giedion, U, Sierra, A, Andrés, E, Diaz, YB & Savedoff, WD 2007, 'The Impact of Subsidized Health Insurance on Access, Utilization and Health Status in Colombia',.
- Goldenberg, R & McClure, E 2018, 'Importance of prenatal care in reducing stillbirth', *BJOG: An International Journal of Obstetrics & Gynaecology*, vol. 125, no. 2, pp. 148–148.
- Goldie, SJ, Sweet, S, Carvalho, N, Natchu, UCM & Hu, D 2010, 'Alternative strategies to reduce maternal mortality in India: a cost-effectiveness analysis', *PLoS Med*, vol. 7, no. 4, p. e1000264.
- Goli, S, Doshi, R & Perianayagam, A 2013, 'Pathways of economic inequalities in maternal and child health in urban India: a decomposition analysis', *PLoS One*, vol. 8, no. 3, p. e58573.
- Goodman, DC, Fisher, ES, Little, GA, Stukel, TA, Chang, C & Schoendorf, KS 2002, 'The relation between the availability of neonatal intensive care and neonatal mortality', *New England Journal of Medicine*, vol. 346, no. 20, pp. 1538–1544.
- Gopalan, SS, Mutasa, R, Friedman, J & Das, A 2014, 'Health sector demand-side financial incentives in low-and middle-income countries: a systematic review on demand-and supply-side effects', *Social science & medicine*, vol. 100, pp. 72–83.

- Graham, W, Woodd, S, Byass, P, Filippi, V, Gon, G, Virgo, S, Chou, D, Hounton, S, Lozano, R & Pattinson, R 2016, 'Diversity and divergence: the dynamic burden of poor maternal health', *The Lancet*, vol. 388, no. 10056, pp. 2164–2175.
- Graham, WJ, Ahmed, S, Stanton, C, Abou-Zahr, CL & Campbell, OM 2008, 'Measuring maternal mortality: an overview of opportunities and options for developing countries', *BMC medicine*, vol. 6, no. 1, pp. 1–8.
- Graham, WJ, Bell, JS & Bullough, CH 2001, 'Can skilled attendance at delivery reduce maternal mortality in developing countries?', *Safe motherhood strategies: a review of the evidence*.
- Greb, AE, Pauli, RM & Kirby, RS 1987, 'Accuracy of fetal death reports: comparison with data from an independent stillbirth assessment program.', *American journal of public health*, vol. 77, no. 9, pp. 1202–1206.
- Gruber, J, Hendren, N & Townsend, RM 2014, 'The great equalizer: Health care access and infant mortality in Thailand', *American Economic Journal: Applied Economics*, vol. 6, no. 1, pp. 91–107.
- Guliani, H, Sepehri, A & Serieux, J 2013, 'Determinants of prenatal care use: evidence from 32 low-income countries across Asia, Sub-Saharan Africa and Latin America', *Health Policy and Planning*, p. czt045.
- Gülmezoglu, AM, Lawrie, TA, Hezelgrave, N, Oladapo, OT, Souza, JP, Gielen, M, Lawn, JE, Bahl, R, Althabe, F & Colaci, D 2016, 'Interventions to reduce maternal and newborn morbidity and mortality'.
- Gumanga, S, Kolbila, D, Gandua, B, Munkaila, A, Malechi, H & Kyei-Aboagye, K 2011, 'Trends in Maternal Morlility in Tamale Teaching Hospital, Ghana', *Ghana medical journal*, vol. 45, no. 3.
- Gupta, A, Fledderjohann, J, Reddy, H, Raman, VR, Stuckler, D & Vellakkal, S 2018, 'Barriers and prospects of India's conditional cash transfer program to promote institutional delivery care: a qualitative analysis of the supply-side perspectives', *BMC Health Services Research*, vol. 18, no. 1, p. 40.
- Gupta, V, Kraemer, JD, Katz, R, Jha, AK, Kerry, VB, Sane, J, Ollgren, J & Salminen, MO 2018, 'Analysis of results from the Joint External Evaluation: examining its strength and assessing for trends among participating countries', *Journal of Global Health*, vol. 8, no. 2, p. 020416.
- Hadju, V & Nursyamsi, I 2020, 'Analysis of integrated health referral systems in the era of regional autonomy in West Sulawesi', *Enfermería Clínica*, vol. 30, pp. 59–62.

- Hafeez, A, Mohamud, BK, Shiekh, MR, Shah, SAI & Jooma, R 2011, 'Lady health workers programme in Pakistan: challenges, achievements and the way forward', *JPMA: Journal of the Pakistan Medical Association*, vol. 61, no. 3, p. 210.
- Haider, MR, Qureshi, ZP & Khan, MM 2017, 'Effects of women's autonomy on maternal healthcare utilization in Bangladesh: Evidence from a national survey', *Sexual & Reproductive Healthcare*, vol. 14, pp. 40–47.
- Hanson, C, Cox, J, Mbaruku, G, Manzi, F, Gabrysch, S, Schellenberg, D, Tanner, M, Ronsmans, C & Schellenberg, J 2015, 'Maternal mortality and distance to facility-based obstetric care in rural southern Tanzania: a secondary analysis of cross-sectional census data in 226 000 households', *The Lancet Global Health*, vol. 3, no. 7, pp. e387–e395.
- Hanson, C, Ronsmans, C, Penfold, S, Maokola, W, Manzi, F, Jaribu, J, Mbaruku, G, Mshinda, H, Tanner, M & Schellenberg, J 2013, 'Health system support for childbirth care in Southern Tanzania: results from a health facility census', *BMC research notes*, vol. 6, no. 1, pp. 1–11.
- Harimurti, P, Pambudi, E, Pigazzini, A & Tandon, A 2013, 'The Nuts & Bolts of Jamkesmas Indonesia's Government-Financed Health Coverage Program', *UNICO Studies Series*, vol. 8.
- Harter, L, Starzyk, P & Frost, F 1986, 'A comparative study of hospital fetal death records and Washington State fetal death certificates.', *American journal of public health*, vol. 76, no. 11, pp. 1333–1334.
- Hawthorne, G 2011, 'Maternal complications in diabetic pregnancy', *Best practice & research Clinical obstetrics & gynaecology*, vol. 25, no. 1, pp. 77–90.
- Health Policy Plus & TNP2K, (Tim Nasional Percepatan Penanggulangan Kemiskinan) 2018, *Pasar Sektor Kesehatan Swasta di Era JKN*, Health Policy Plus, Tim Nasional Percepatan Penanggulangan Kemiskinan (TNP2K), Jakarta, Indonesia, accessed July 15, 2020, from <http://www.healthpolicyplus.com/ns/pubs/8224-9414_IndonesiaJKNMarketImpactBriefBahasa.pdf>.
- Heslehurst, N, Rankin, J, Wilkinson, JR & Summerbell, CD 2010, 'A nationally representative study of maternal obesity in England, UK: trends in incidence and demographic inequalities in 619 323 births, 1989–2007', *International Journal of Obesity*, vol. 34, no. 3, pp. 420–428.
- Heywood, P & Choi, Y 2010, 'Health system performance at the district level in Indonesia after decentralization', *BMC international health and human rights*, vol. 10, no. 1, p. 1.

- Heywood, PF & Harahap, NP 2009, 'Human resources for health at the district level in Indonesia: the smoke and mirrors of decentralization', *Human Resources for Health*, vol. 7, no. 1, p. 1.
- Hidayat, B & Pokhrel, S 2010, 'The selection of an appropriate count data model for modelling health insurance and health care demand: Case of Indonesia', *International Journal of Environmental Research and Public Health*, vol. 7, no. 1, pp. 9–27.
- Hill, K & Choi, Y 2006, 'Neonatal mortality in the developing world', *Demographic research*, vol. 14, pp. 429–452.
- Hodge, A, Byrne, A, Morgan, A & Jimenez-Soto, E 2015, 'Utilisation of health services and geography: deconstructing regional differences in barriers to facility-based delivery in Nepal', *Maternal and Child Health Journal*, vol. 19, no. 3, pp. 566–577.
- Hodge, A, Firth, S, Marthias, T & Jimenez-Soto, E 2014, 'Location matters: trends in inequalities in child mortality in Indonesia. Evidence from repeated cross-sectional surveys', *PLoS ONE*, vol. 9, no. 7, p. e103597.
- Hodgins, S & D'Agostino, A 2014, 'The quality–coverage gap in antenatal care: toward better measurement of effective coverage', *Global Health: Science and Practice*, vol. 2, no. 2, pp. 173–181.
- Homer, CSE, Friberg, IK, Dias, MAB, ten Hoop-Bender, P, Sandall, J, Speciale, AM & Bartlett, LA 2014, 'The projected effect of scaling up midwifery', *The Lancet*, vol. 384, no. 9948, pp. 1146–1157.
- Hone, T, Macinko, J & Millett, C 2018, 'Revisiting Alma-Ata: what is the role of primary health care in achieving the Sustainable Development Goals?', *The Lancet*, vol. 392, no. 10156, pp. 1461–1472.
- Hort, K, Djasri, H & Utarini, A 2013, 'Regulating the quality of health care: lessons from hospital accreditation in Australia and Indonesia', *The Nossal Institute for Global Health, Working Paper Series*, vol. 28.
- Hotchkiss, DR 2001, 'Expansion of rural health care and the use of maternal services in Nepal', *Health & Place*, vol. 7, no. 1, pp. 39–45.
- Hounton, S, De Bernis, L, Hussein, J, Graham, WJ, Danel, I, Byass, P & Mason, EM 2013, 'Towards elimination of maternal deaths: maternal deaths surveillance and response', *Reproductive health*, vol. 10, no. 1, p. 1.

- Houweling, TA, Arroyave, I, Burdorf, A & Avendano, M 2017, 'Health insurance coverage, neonatal mortality and caesarean section deliveries: an analysis of vital registration data in Colombia', *J Epidemiol Community Health*, vol. 71, no. 5, pp. 505–512.
- Houweling, TA, Kunst, AE, Borsboom, G & Mackenbach, JP 2006, 'Mortality inequalities in times of economic growth: time trends in socioeconomic and regional inequalities in under 5 mortality in Indonesia, 1982–1997', *Journal of Epidemiology and Community Health*, vol. 60, no. 1, pp. 62–68.
- Houweling, TA, Kunst, AE, Huisman, M & Mackenbach, JP 2007, 'Using relative and absolute measures for monitoring health inequalities: experiences from cross-national analyses on maternal and child health', *International Journal for Equity in Health*, vol. 6, no. 1, p. 15.
- Houweling, TA, Kunst, AE & Mackenbach, JP 2003, 'Measuring health inequality among children in developing countries: does the choice of the indicator of economic status matter?', *International Journal for Equity in Health*, vol. 2, no. 1, p. 8.
- Houweling, TA, Ronsmans, C, Campbell, OM & Kunst, AE 2007, 'Huge poor-rich inequalities in maternity care: an international comparative study of maternity and child care in developing countries', *Bulletin of the World Health Organization*, vol. 85, no. 10, pp. 745–754.
- Houweling, TAJ & Kunst, AE 2010, 'Socio-economic inequalities in childhood mortality in low- and middle-income countries: a review of the international evidence', *British Medical Bulletin*, vol. 93, no. 1, pp. 7–26.
- Hsiao, WC 2003, 'What is a health system? Why should we care', *Harvard School of Public Health, working paper*, vol. 33.
- Hug, L, Alexander, M, You, D, Alkema, L & for Child, UIG 2019, 'National, regional, and global levels and trends in neonatal mortality between 1990 and 2017, with scenario-based projections to 2030: a systematic analysis', *The Lancet Global Health*, vol. 7, no. 6, pp. e710–e720.
- Hull, T 2007, 'Formative years of family planning in Indonesia', in *The Global Family Planning Revolution*, The World Bank, Washington DC.
- Hull, TH 2010, 'Estimates of Indonesian population numbers: first impressions from the 2010 census', *Bulletin of Indonesian Economic Studies*, vol. 46, no. 3, pp. 371–375.
- Hull, TH & Hull, VJ 1977, *Indonesia's family planning story: Success and challenges*, Population Reference Bureau, Inc., Washington DC, accessed July 15, 2020, from <https://www.researchgate.net/profile/Terence_Hull/publication/11145612_Indone

sia's_family_planning_story_Success_and_challenge/links/551b6bf30cf2fdce84389d08.pdf>.

Hull, TH, Hull, VJ & Singarimbun, M 1977, *Indonesia's family planning story: Success and challenge*, Population Reference Bureau.

Hurst, JW 1991, 'Reforming health care in seven European nations', *Health Affairs*, vol. 10, no. 3, pp. 7–21.

Huzaipa, H 2014, 'Evaluasi Kebijakan Program Keluarga Harapan Di Kecamatan Sigi Biromaru Kabupaten Sigi', *Katalogis*, vol. 2, no. 7, accessed from <<http://jurnal.untad.ac.id/jurnal/index.php/Katalogis/article/view/6917>>.

ICF 2018, *Demographic and Health Surveys Standard Recode Manual for DHS7. The Demographic and Health Surveys Program*, ICF, Rockville, Maryland, U.S.A., accessed October 10, 2019, from <https://dhsprogram.com/pubs/pdf/DHSG4/Recode7_DHS_10Sep2018_DHSG4.pdf>.

Indonesia MOH 1998, *Indonesia Health Profile 1997*, Indonesia Ministry of Health.

Indonesia MOH 2016, *Minimum Service Standard in Health 2016*, Indonesia Ministry of Health, accessed March 19, 2019, from <<http://ditjenpp.kemenumham.go.id/arsip/bn/2016/bn1475-2016.pdf>>.

Indonesia MOH 2020, *Indonesia Health Profile 2019*, Indonesia Ministry of Health, accessed July 15, 2020, from <<https://pusdatin.kemkes.go.id/resources/download/pusdatin/profil-kesehatan-indonesia/Profil-Kesehatan-indonesia-2019.pdf>>.

Indonesia National Bureau of Planning and Development, Government of Central Java & United Nations Indonesia 2013, *Indonesia: accelerating progress towards improving maternal health in Central Java*, Indonesia National Bureau of Planning and Development (Bappenas), Jakarta, Indonesia.

Indonesian Medical Council 2020, *Daftar Fakultas Kedokteran Indonesia*, Konsil Kedokteran Indonesia, Jakarta, Indonesia, accessed September 24, 2020, from <<http://kki.go.id/index.php/informasi/index/246/1529/1543>>.

Jakarta Province Health Office 2016, 'Ketuk Pintu Layani Dengan Hati (KPLDH) Program Baru Dinas Kesehatan Provinsi DKI Jakarta', accessed October 16, 2020, from <<http://smartcity.jakarta.go.id/blog/117/ketuk-pintu-layani-dengan-hati-kpldh-program-baru-dinas-kesehatan-provinsi-dki-jakarta>>.

- Jandoc, R, Burden, AM, Mamdani, M, Lévesque, LE & Cadarette, SM 2015, 'Interrupted time series analysis in drug utilization research is increasing: systematic review and recommendations', *Journal of Clinical Epidemiology*, vol. 68, no. 8, pp. 950–956.
- Jewell, BL, Mudimu, E, Stover, J, Ten Brink, D, Phillips, AN, Smith, JA, Martin-Hughes, R, Teng, Y, Glaubius, R & Mahiane, SG 2020, 'Potential effects of disruption to HIV programmes in sub-Saharan Africa caused by COVID-19: results from multiple mathematical models', *The Lancet HIV*, vol. 7, no. 9, pp. e629–e640.
- Jimenez Soto, E, La Vincente, S, Clark, A, Firth, S, Morgan, A, Dettrick, Z, Dayal, P, Aldaba, BM, Kosen, S, Kraft, AD, Panicker, R, Prasai, Y, Trisnantoro, L, Varghese, B & Widiati, Y 2013, 'Investment case for improving maternal and child health: results from four countries', *BMC Public Health*, vol. 13, no. 1, p. 601.
- Jimenez-Soto, E, Durham, J & Hodge, A 2014, 'Entrenched geographical and socioeconomic disparities in child mortality: trends in absolute and relative inequalities in Cambodia', *PloS One*, vol. 9, no. 10, p. e109044.
- Johar, M 2009, 'The impact of the Indonesian health card program: a matching estimator approach', *Journal of health economics*, vol. 28, no. 1, pp. 35–53.
- Jones, FL 1983, 'On decomposing the wage gap: a critical comment on Blinder's method', *The Journal of Human Resources*, vol. 18, no. 1, pp. 126–130.
- Joseph, G, da Silva, ICM, Barros, AJD & Victora, CG 2018, 'Socioeconomic inequalities in access to skilled birth attendance among urban and rural women in low-income and middle-income countries', *BMJ Global Health*, vol. 3, no. 6, p. e000898.
- Kakwani, N, Wagstaff, A & Van Doorslaer, E 1997, 'Socioeconomic inequalities in health: measurement, computation, and statistical inference', *Journal of econometrics*, vol. 77, no. 1, pp. 87–103.
- Kanchanachitra, C, Lindelow, M, Johnston, T, Hanvoravongchai, P, Lorenzo, F, Huong, N, Wilopo, S & De la Rosa, J 2011, 'Human resources for health in southeast Asia: shortages, distributional challenges, and international trade in health services', *The Lancet*, vol. 377, no. 9767, pp. 769–81.
- Kanyangarara, M, Munos, MK & Walker, N 2017, 'Quality of antenatal care service provision in health facilities across sub-Saharan Africa: Evidence from nationally representative health facility assessments', *Journal of Global Health*, vol. 7, no. 2, accessed September 22, 2020, from <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5680531/>>.

- Karim, QA & Karim, SSA 2020, 'COVID-19 affects HIV and tuberculosis care', *Science*, vol. 369, no. 6502, pp. 366–368.
- Karlsen, S, Say, L, Souza, J-P, Hogue, CJ, Calles, DL, Gülmezoglu, AM & Raine, R 2011, 'The relationship between maternal education and mortality among women giving birth in health care institutions: analysis of the cross sectional WHO Global Survey on Maternal and Perinatal Health', *BMC public health*, vol. 11, no. 1, p. 606.
- Kaslam, P 2014, 'Indonesia's plan to save newborn lives', *Healthy Newborn Network*, accessed August 31, 2020, from <https://www.healthynewbornnetwork.org/blog/indonesias-plan-to-save-newborn-lives/>.
- Kassebaum, NJ, Barber, RM, Bhutta, ZA, Dandona, L, Gething, PW, Hay, SI, Kinfu, Y, Larson, HJ, Liang, X & Lim, SS 2016, 'Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015', *The Lancet*, vol. 388, no. 10053, pp. 1775–1812.
- Kerber, KJ, de Graft-Johnson, JE, Bhutta, ZA, Okong, P, Starrs, A & Lawn, JE 2007, 'Continuum of care for maternal, newborn, and child health: from slogan to service delivery', *The Lancet*, vol. 370, no. 9595, pp. 1358–1369.
- Kitui, J, Lewis, S & Davey, G 2013, 'Factors influencing place of delivery for women in Kenya: an analysis of the Kenya demographic and health survey, 2008/2009', *BMC pregnancy and childbirth*, vol. 13, no. 1, p. 40.
- Knight, M, Nair, M, Tuffnell, D, Kenyon, S, Shakespeare, J, Brocklehurst, P & Kurinczuk, J 2016, 'Saving Lives, Improving Mothers' Care: Surveillance of maternal deaths in the UK 2012-14 and lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009-14',.
- Kolola, T, Ekubay, M, Tesfa, E & Morka, W 2016, 'Determinants of Neonatal Mortality in North Shoa Zone, Amhara Regional State, Ethiopia', *PLOS ONE*, vol. 11, no. 10, p. e0164472.
- Konadu, SO, Owusu, SK, Osei-Akoto, A, Nyarko, OO, Opoku, G & Osei, FA 2019, 'Pneumonia dominance in under-five mortalities in sub-Saharan Africa-Urgency for more research and capacity improvement', *African Journal of Current Medical Research*, vol. 3, no. 1.
- Kosen, S 2015, 'The development of the Indonesian Sample Registration System (SRS)',.
- Kosen, S, Tarigan, I, Usman, Y, Suryati, T, Indriasih, E, Muas, I, Widyastuti, R, Luciana, M, Rosita, T & Hapsari, D 2014, *Universal maternal health coverage?: assessing the*

readiness of public health facilities to provide maternal health care in Indonesia, The World Bank.

- Kristiansen, S & Santoso, P 2006, 'Surviving decentralisation?: Impacts of regional autonomy on health service provision in Indonesia', *Health Policy*, vol. 77, no. 3, pp. 247–259.
- Kruk, ME, Gage, AD, Arsenault, C, Jordan, K, Leslie, HH, Roder-DeWan, S, Adeyi, O, Barker, P, Daelmans, B & Doubova, SV 2018, 'High-quality health systems in the Sustainable Development Goals era: time for a revolution', *The Lancet Global Health*, vol. 6, no. 11, pp. e1196–e1252.
- Kruk, ME, Hermosilla, S, Larson, E & Mbaruku, GM 2014, 'Bypassing primary care clinics for childbirth: a cross-sectional study in the Pwani region, United Republic of Tanzania', *Bulletin of the World Health Organization*, vol. 92, pp. 246–253.
- Kruk, ME, Kujawski, S, Moyer, CA, Adanu, RM, Afsana, K, Cohen, J, Glassman, A, Labrique, A, Reddy, KS & Yamey, G 2016, 'Next generation maternal health: external shocks and health-system innovations', *The Lancet*.
- Kruk, ME & Prescott, MR 2012, 'The role of health systems and policies in promoting safe delivery in low-and middle-income countries: a multilevel analysis', *American journal of public health*, vol. 102, no. 4, pp. 645–650.
- Kurniati, A, Chen, C-M, Efendi, F & Berliana, SM 2018, 'Factors influencing Indonesian women's use of maternal health care services', *Health care for women international*, vol. 39, no. 1, pp. 3–18.
- Lagarde, M & Palmer, N 2008, 'The impact of user fees on health service utilization in low-and middle-income countries: how strong is the evidence?', *Bulletin of the World Health Organization*, vol. 86, pp. 839-848C.
- Lassi, ZS, Mallick, D, Das, JK, Mal, L, Salam, RA & Bhutta, ZA 2014, 'Essential interventions for child health', *Reproductive Health*, vol. 11, no. Suppl 1, p. S4.
- Lawn, J, Shibuya, K & Stein, C 2005, 'No cry at birth: global estimates of intrapartum stillbirths and intrapartum-related neonatal deaths', *Bulletin of the World Health Organization*, vol. 83, pp. 409–417.
- Lawn, JE, Cousens, S, Zupan, J, & Lancet Neonatal Survival Steering Team 2005, '4 million neonatal deaths: when? Where? Why?', *The lancet*, vol. 365, no. 9462, pp. 891–900.
- Lawn, JE, Kerber, K, Enweronu-Laryea, C & Cousens, S 2010, '3.6 million neonatal deaths—what is progressing and what is not?', in Elsevier, pp. 371–386, accessed September

- 1, 2020, from <http://www.healthynewbornnetwork.org/hnn-content/uploads/Epidemiology_Lawn.pdf>.
- Leeder, SR 2003, 'Achieving equity in the Australian healthcare system', *Medical Journal of Australia*, vol. 179, no. 9, pp. 475–478.
- Lehtonen, L, Gimeno, A, Parra-Llorca, A & Vento, M 2017, 'Early neonatal death: a challenge worldwide', in Elsevier, pp. 153–160.
- Leslie, HH, Malata, A, Ndiaye, Y & Kruk, ME 2017, 'Effective coverage of primary care services in eight high-mortality countries', *BMJ Global Health*, vol. 2, no. 3, p. e000424.
- Li, J 2004, 'Gender inequality, family planning, and maternal and child care in a rural Chinese county', *Social Science & Medicine*, vol. 59, no. 4, pp. 695–708.
- Liang, J, Dai, L, Zhu, J, Li, X, Zeng, W, Wang, H, Li, Q, Li, M, Zhou, R & Wang, Y 2011, 'Preventable maternal mortality: geographic/rural-urban differences and associated factors from the population-based Maternal Mortality Surveillance System in China', *BMC Public Health*, vol. 11, no. 1, p. 243.
- Lieberman, SS, Capuno, JJ & Van Minh, H 2005, 'Decentralizing health: lessons from Indonesia, the Philippines, and Vietnam', *East Asia decentralizes: Making local government work*, pp. 155–178.
- Lin, H-C, Xirasagar, S & Tung, Y-C 2006, 'Impact of a cultural belief about ghost month on delivery mode in Taiwan', *Journal of Epidemiology & Community Health*, vol. 60, no. 6, pp. 522–526.
- Liu, L, Hill, K, Oza, S, Hogan, D, Chu, Y, Cousens, S, Mathers, C, Stanton, C, Lawn, J & Black, RE 2016, 'Levels and causes of mortality under age five years'.
- Liu, L, Johnson, HL, Cousens, S, Perin, J, Scott, S, Lawn, JE, Rudan, I, Campbell, H, Cibulskis, R & Li, M 2012, 'Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000', *The Lancet*, vol. 379, no. 9832, pp. 2151–2161.
- van Lonkhuijzen, L, Stekelenburg, J & van Roosmalen, J 2012, 'Maternity waiting facilities for improving maternal and neonatal outcome in low-resource countries', *Cochrane database of systematic reviews*, no. 10.
- López-López, E, Gutiérrez-Soria, D & Idrovo, AJ 2012, 'Evaluation of a diabetes care program using the effective coverage framework', *International Journal for Quality in Health Care*, vol. 24, no. 6, pp. 619–625.

- Lozano, R, Soliz, P, Gakidou, E, Abbott-Klafter, J, Feehan, DM, Vidal, C, Ortiz, JP & Murray, CJ 2006, 'Benchmarking of performance of Mexican states with effective coverage', *The Lancet*, vol. 368, no. 9548, pp. 1729–1741.
- Mahendradhata, Y, Trisnantoro, L, Dewi, S, Soewondo, P, Marthias, T, Harimurti, P & Prawira, J 2017, *The Republic of Indonesia Health System Review*, WHO Regional Office for South-East Asia, accessed July 15, 2020, from <<https://apps.who.int/iris/handle/10665/254716>>.
- Maimbolwa, MC, Yamba, B, Diwan, V & Ransjö-Arvidson, A 2003, 'Cultural childbirth practices and beliefs in Zambia', *Journal of advanced nursing*, vol. 43, no. 3, pp. 263–274.
- Makenzius, M, McKinney, G, Oguttu, M & Romild, U 2019, 'Stigma related to contraceptive use and abortion in Kenya: scale development and validation', *Reproductive Health*, vol. 16, no. 1, p. 136.
- Makowiecka, K, Achadi, E, Izati, Y & Ronsmans, C 2008, 'Midwifery provision in two districts in Indonesia: how well are rural areas served?', *Health Policy and Planning*, vol. 23, no. 1, pp. 67–75.
- Marniyati, L, Saleh, I & Soebyakto, BB 2016, 'Pelayanan Antenatal Berkualitas dalam Meningkatkan Deteksi Risiko Tinggi pada Ibu Hamil oleh Tenaga Kesehatan di Puskesmas Sako, Sosial, Sei Baung dan Sei Selincah di Kota Palembang', *Jurnal Kedokteran dan Kesehatan: Publikasi Ilmiah Fakultas Kedokteran Universitas Sriwijaya*, vol. 3, no. 1, pp. 355–362.
- Maro, EW, Mosha, NR, Mahande, MJ, Obure, J & Masenga, G 2016, 'Ten years trend in maternal mortality at Kilimanjaro Christian Medical Center Tanzania, 2003–2012: A descriptive retrospective tertiary hospital based study', *Asian Pacific Journal of Reproduction*, vol. 5, no. 3, pp. 214–220.
- Marsh, AD, Muzigaba, M, Diaz, T, Requejo, J, Jackson, D, Chou, D, Cresswell, JA, Guthold, R, Moran, AC & Strong, KL 2020, 'Effective coverage measurement in maternal, newborn, child, and adolescent health and nutrition: progress, future prospects, and implications for quality health systems', *Lancet Global Health*, vol. 8, no. 5, pp. e730–e736.
- Martines, J, Paul, VK, Bhutta, ZA, Koblinsky, M, Soucat, A, Walker, N, Bahl, R, Fogstad, H, Costello, A, & Lancet Neonatal Survival Steering Team 2005, 'Neonatal survival: a call for action', *The Lancet*, vol. 365, no. 9465, pp. 1189–1197.
- Martinez, S, Carrasquilla, G, Guerrero, R, Gómez-Dantés, H, Castro, V, Arreola-Ornelas, H & Bedregal, P 2011, 'Effective coverage of health interventions in Latin America and

- the Caribbean: metrics for the assessment of health systems performance', *Salud publica de Mexico*, vol. 53, pp. 578-84.
- Maswime, S & Buchmann, E 2017, 'A systematic review of maternal near miss and mortality due to postpartum hemorrhage', *Int J Gynaecol Obstet*, vol. 137, no. 1, pp. 1–7.
- Mboi, N 2015, 'Indonesia: on the way to universal health care', *Health Systems & Reform*, vol. 1, no. 2, pp. 91–97.
- Mboi, N, Surbakti, IM, Trihandini, I, Elyazar, I, Smith, KH, Ali, PB, Kosen, S, Flemons, K, Ray, SE & Cao, J 2018, 'On the road to universal health care in Indonesia, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016', *The Lancet*, vol. 392, no. 10147, pp. 581–591.
- Mc Donagh, M & Goodburn, E 2001, 'Maternal health and health sector reform: opportunities and challenges', in *Safe motherhood strategies: a review of the evidence*, ITG Press, Antwerp, pp. 371–385, accessed September 1, 2020, from <<http://dspace.itg.be/bitstream/handle/10390/2664/2001shsop0367.pdf?sequence=2>>.
- McCarthy, KJ, Blanc, AK, Warren, CE, Kimani, J, Mdawida, B & Ndwidga, C 2016, 'Can surveys of women accurately track indicators of maternal and newborn care? A validity and reliability study in Kenya', *Journal of global health*, vol. 6, no. 2.
- McKinnon, B, Harper, S, Kaufman, JS & Abdullah, M 2014, 'Distance to emergency obstetric services and early neonatal mortality in Ethiopia', *Tropical medicine & international health : TM & IH*, vol. 19, no. 7, pp. 780–90.
- McPake, B & Edoka, I 2014, 'Universal health coverage reforms: implications for the distribution of the health workforce in low and middle-income countries', *WHO South-East Asia Journal of Public Health*, vol. 3, no. 3–4, pp. 213–218.
- McTavish, S, Moore, S, Harper, S & Lynch, J 2010, 'National female literacy, individual socio-economic status, and maternal health care use in sub-Saharan Africa', *Social science & medicine*, vol. 71, no. 11, pp. 1958–1963.
- MEASURE Evaluation 2017, 'Method information index', accessed August 19, 2020, from <https://www.measureevaluation.org/prh/rh_indicators/family-planning/method-choice/method-information-index>.
- Meliala, A, Hort, K & Trisnantoro, L 2013, 'Addressing the unequal geographic distribution of specialist doctors in Indonesia: the role of the private sector and effectiveness of current regulations', *Social Science & Medicine*, vol. 82, pp. 30–34.

- Mensah, J, Oppong, JR & Schmidt, CM 2010, 'Ghana's National Health Insurance Scheme in the context of the health MDGs: An empirical evaluation using propensity score matching', *Health economics*, vol. 19, no. S1, pp. 95–106.
- Mgawadere, F, Kana, T & van den Broek, N 2017, 'Measuring maternal mortality: a systematic review of methods used to obtain estimates of the maternal mortality ratio (MMR) in low- and middle-income countries.', *British Medical Bulletin*, vol. 121, no. 1, pp. 121–134.
- Ministry of Finance 2020a, 'Ministry of Finance data portal', *Portal data*, accessed July 15, 2020, from <<http://www.djpk.kemenkeu.go.id/portal/data/apbd>>.
- Ministry of Finance 2020b, 'APBN 2020', accessed October 17, 2020, from <<https://www.kemenkeu.go.id/apbn2020>>.
- Ministry of Health 2000, *Indicators for the third evaluation of HFA*, Ministry of Health, Jakarta.
- Ministry of Health 2008, *Rencana Strategis Nasional Making Pregnancy Safer (MPS) di Indonesia 2001-2010.*, Ministry of Health General Secretariate, Jakarta.
- Ministry of Health 2016, 'Minister of Health Regulation No. 52/2016 on health service standard tariffs in National Health Insurance implementation', accessed July 15, 2019, from <http://hukor.kemkes.go.id/uploads/produk_hukum/PMK_No._52_Tahun_2016_Tentang_Standar_Tarif_Pelayanan_Kesehatan_Dalam_Penyelenggaraan_JKN_.pdf>.
- Ministry of Health 2017, 'Permenkes No. 34 Tahun 2017 tentang Akreditasi Rumah Sakit', accessed October 23, 2020, from <<https://peraturan.bpk.go.id/Home/Details/112098/permenkes-no-34-tahun-2017>>.
- Ministry of Health 2018, 'Permenkes No. 33 Tahun 2018 tentang Penugasan Khusus Tenaga Kesehatan Dalam Mendukung Program Nusantara Sehat', accessed October 16, 2020, from <<https://peraturan.bpk.go.id/Home/Details/111947/permenkes-no-33-tahun-2018>>.
- Ministry of Health 2019a, 'Permenkes No. 3 Tahun 2019 tentang Juknis penggunaan Dana alokasi khu...', accessed September 25, 2020, from <<https://www.slideshare.net/ulfahhanum1/pmk-no-3th2019ttgjuknispenggunaandanaalokasikhususnonfisikbidangkesehatan>>.
- Ministry of Health 2019b, 'Ministry of Health regulation on Puskesmas No. 4 2019', accessed September 14, 2020, from <https://drive.google.com/file/d/15ydnkEyatS4hba2jiOYTKvbwv15Oh_Hm/view>.

- Ministry of Health Indonesia 2014, *Peraturan menteri kesehatan no. 97 tentang pelayanan kesehatan kehamilan*, Ministry of Health, Jakarta, Indonesia, accessed August 10, 2020, from <http://kesga.kemkes.go.id/images/pedoman/PMK%20No.%2097%20ttg%20Pelayanan%20Kesehatan%20Kehamilan.pdf>.
- Ministry of Social Affairs 2020, 'Program Keluarga Harapan', accessed September 25, 2020, from <https://pkh.kemsos.go.id/?pg=tentangpkh-1>.
- MoH 2007, *HMN Indonesia health information system review and assessment.*, Centre for Data and Information of the Ministry of Health of the Republic of Indonesia, Jakarta.
- MoH 2014, *Ministry of Health Regulation on Reproductive Health Services*, accessed September 20, 2019, from <http://kesga.kemkes.go.id/images/pedoman/PMK%20No.%2097%20ttg%20Pelayanan%20Kesehatan%20Kehamilan.pdf>.
- MoH 2016, 'Peran Kementerian Kesehatan dalam menyusun sistem rujukan di Indonesia', accessed September 25, 2020, from https://drive.google.com/file/d/0B2ieVb7Js5Z1UVpuQ3Q2VnhHMF6/view?usp=sharing&usp=embed_facebook.
- Mohanty, SK, Kim, R, Khan, PK & Subramanian, SV 2018, 'Geographic Variation in Household and Catastrophic Health Spending in India: Assessing the Relative Importance of Villages, Districts, and States, 2011-2012', *The Milbank Quarterly*, vol. 96, no. 1, pp. 167–206.
- Morof, D, Serbanescu, F, Goodwin, MM, Hamer, DH, Asiimwe, AR, Hamomba, L, Musumali, M, Binzen, S, Kekitiinwa, A & Picho, B 2019, 'Addressing the third delay in Saving Mothers, Giving Life districts in Uganda and Zambia: ensuring adequate and appropriate facility-based maternal and perinatal health care', *Global Health: Science and Practice*, vol. 7, no. Supplement 1, pp. S85–S103.
- Mosites, E, Hackleman, R, Weum, KLM, Pintye, J, Manhart, LE & Hawes, SE 2012, 'BANGLADESH ORS CASE STUDY', , p. 15.
- Movahedi, M, Hajarizadeh, B, Rahimi, A, Arshinchi, M, Amirhosseini, K & Haghdoost, AA 2009, 'Trends and geographical inequalities of the main health indicators for rural Iran', *Health policy and planning*, vol. 24, no. 3, pp. 229–237.
- Mulyanto, J, Kringos, DS & Kunst, AE 2019, 'The evolution of income-related inequalities in healthcare utilisation in Indonesia, 1993–2014', *PloS one*, vol. 14, no. 6, p. e0218519.

- Munos, M, Stanton, C & Bryce, J 2017, 'Core Group for Improving Coverage Measurement for M. Improving coverage measurement for reproductive, maternal, neonatal and child health: gaps and opportunities', *Journal of global health*, vol. 7, no. 1, p. 010801.
- Mutiara, VS 2017, 'Hubungan Sikap Petugas Dan Fasilitas Kesehatan Dengan Kepuasan Ibu Hamil Pada Pelayanan ANC', *Jurnal Kesehatan Al-Irsyad*, pp. 39–45.
- Nababan, HY, Hasan, M, Marthias, T, Dhital, R, Rahman, A & Anwar, I 2018, 'Trends and inequities in use of maternal health care services in Indonesia, 1986–2012', *International journal of Women's Health*, vol. 10, p. 11.
- Nasir, M 2011, 'The Majelis Ulama's Fatwā on abortion in contemporary Indonesia', <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1478-1913.2010.01341.x>, vol. 101, no. 01, pp. 33–52.
- Nasir, S, Ahmed, R, Kurniasari, M, Limato, R, Tulloch, O, Syafruddin, D & Koning, K de 2016, 'Challenges that Hinder Parturients to Deliver in Health Facilities: A Qualitative Analysis in Two Districts of Indonesia', *Makara Journal of Health Research*, pp. 79–87.
- Nasution, SK, Mahendradhata, Y & Trisnantoro, L 2019, 'Can a National Health Insurance Policy Increase Equity in the Utilization of Skilled Birth Attendants in Indonesia? A Secondary Analysis of the 2012 to 2016 National Socio-Economic Survey of Indonesia', *Asia Pacific Journal of Public Health*, p. 1010539519892394.
- National Board of Social Insurance, Ministry of Health, Ministry of Health, Ministry of Finance, Ministry of National Enterprise, Ministry of Workforce and Transmigration, Ministry of Social Affairs, Ministry of Defense, Ministry of Home Affairs, Indonesia Military and Police Force, TNP2K, PT Askes & PT Jamsostek 2012, *Peta Jalan Menuju Jaminan Kesehatan Nasional 2012-2019*, Republic of Indonesia, Jakarta, Indonesia, accessed January 27, 2020, from <<https://djsn.go.id/draft-panduan/peta-jalan-menuju-jaminan-kesehatan-nasional>>.
- National Population and Family Planning Board (BKKBN), SI (BPS), Health (Kemenkes), M of, & ICF 2018, *Indonesia Demographic and Health Survey 2017*, BKKBN, BPS, Kemenkes, and ICF, Jakarta, Indonesia, accessed from <<https://dhsprogram.com/pubs/pdf/FR342/FR342.pdf>>.
- National Population and Family Planning Board (BKKBN), Statistics Indonesia (BPS), Ministry of Health (Kemenkes) & ICF 2018, *Indonesia Demographic and Health Survey 2017*, BKKBN, BPS, Kemenkes, and IF, Jakarta, Indonesia, accessed from <<https://dhsprogram.com/pubs/pdf/FR342/FR342.pdf>>.

- National Population and Family Planning Board (BKKBN), Statistics Indonesia (BPS), Ministry of Health (Kemenkes) & ICF 2018, *Indonesia Demographic and Health Survey 2017*, BKKBN, BPS, Kemenkes, and ICF, Jakarta, Indonesia, accessed from <<https://dhsprogram.com/pubs/pdf/FR342/FR342.pdf>>.
- Navaneetham, K & Dharmalingam, A 2002, 'Utilization of maternal health care services in Southern India', *Social science & medicine*, vol. 55, no. 10, pp. 1849–1869.
- Neal, S, Channon, AA, Carter, S & Falkingham, J 2015, 'Universal health care and equity: evidence of maternal health based on an analysis of demographic and household survey data', *International Journal for Equity in Health*, vol. 14, no. 1, p. 56.
- Neumark, D 1988, 'Employers' Discriminatory Behavior and the Estimation of Wage Discrimination', *Journal of Human Resources*, vol. 23, no. 3, pp. 279–295.
- Ng, M, Fullman, N, Dieleman, JL, Flaxman, AD, Murray, CJ & Lim, SS 2014, 'Effective coverage: a metric for monitoring universal health coverage', *PLoS medicine*, vol. 11, no. 9.
- Ngoc, NTN, Merialdi, M, Abdel-Aleem, H, Carroli, G, Purwar, M, Zavaleta, N, Campódonico, L, Ali, MM, Hofmeyr, GJ & Mathai, M 2006, 'Causes of stillbirths and early neonatal deaths: data from 7993 pregnancies in six developing countries', *Bulletin of the World Health Organization*, vol. 84, pp. 699–705.
- Nguhiu, PK, Barasa, EW & Chuma, J 2017, 'Determining the effective coverage of maternal and child health services in Kenya, using demographic and health survey data sets: tracking progress towards universal health coverage', *Tropical Medicine & International Health*, vol. 22, no. 4, pp. 442–453.
- Nguyen, CV 2012, 'The impact of voluntary health insurance on health care utilization and out-of-pocket payments: New evidence for Vietnam', *Health economics*, vol. 21, no. 8, pp. 946–966.
- Nigatu, D, Gebremariam, A, Abera, M, Setegn, T & Deribe, K 2014, 'Factors associated with women's autonomy regarding maternal and child health care utilization in Bale Zone: a community based cross-sectional study', *BMC Women's Health*, vol. 14, no. 1, p. 79.
- NIHRD 2013, *Indonesia Basic Health Research 2010*, Indonesia Ministry of Health, Jakarta.
- NIHRD 2017, 'RISET EVALUASI NUSANTARA SEHAT - PDF Download Gratis', accessed October 16, 2020, from <<https://docplayer.info/62721965-Riset-evaluasi-nusantara-sehat.html>>.

- Nugraheni, WP, Mubasyiroh, R & Hartono, RK 2020, 'The influence of Jaminan Kesehatan Nasional (JKN) on the cost of delivery services in Indonesia', *Plos one*, vol. 15, no. 7, p. e0235176.
- Nurhidayanti, S, Margawati, A & Kartasurya, MI 2018, 'Kepercayaan masyarakat terhadap penolong persalinan di wilayah Halmahera Utara', *Jurnal Promosi Kesehatan Indonesia*, vol. 13, no. 1, pp. 46–60.
- Nyamtema, AS, Mwakatundu, N, Dominico, S, Mohamed, H, Pemba, S, Rumanyika, R, Kairuki, C, Kassiga, I, Shayo, A & Issa, O 2016, 'Enhancing maternal and perinatal health in under-served remote areas in sub-Saharan Africa: a Tanzanian model', *PLoS One*, vol. 11, no. 3, p. e0151419.
- Nyongesa, C, Xu, X, Hall, JJ, Macharia, WM, Yego, F & Hall, B 2018, 'Factors influencing choice of skilled birth attendance at ANC: evidence from the Kenya demographic health survey', *BMC Pregnancy and Childbirth*, vol. 18, no. 1, p. 88.
- Oaxaca, R 1973, 'Male-female wage differentials in urban labor markets', *International Economic Review*, vol. 14, no. 3, pp. 693–709.
- Oaxaca, RL & Ransom, MR 1994, 'On discrimination and the decomposition of wage differentials', *Journal of Econometrics*, vol. 61, no. 1, pp. 5–21.
- Ologunde, R, Vogel, JP, Cherian, MN, Sbaiti, M, Merialdi, M & Yeats, J 2014, 'Assessment of cesarean delivery availability in 26 low-and middle-income countries: a cross-sectional study', *American journal of obstetrics and gynecology*, vol. 211, no. 5, pp. 504-e1.
- Ozgediz, D, Hsia, R, Weiser, T, Gosselin, R, Spiegel, D, Bickler, S, Dunbar, P & McQueen, K 2009, 'Population health metrics for surgery: effective coverage of surgical services in low-income and middle-income countries', *World journal of surgery*, vol. 33, no. 1, p. 1.
- Pacheco, AJC, Katz, L, Souza, ASR & de Amorim, MMR 2014, 'Factors associated with severe maternal morbidity and near miss in the São Francisco Valley, Brazil: a retrospective, cohort study', *BMC pregnancy and childbirth*, vol. 14, no. 1, p. 91.
- Pandey, MR, Daulaire, N, Starbuck, E, Houston, R & McPherson, K 1991, 'Reduction in total under-five mortality in western Nepal through community-based antimicrobial treatment of pneumonia', *The Lancet*, vol. 338, no. 8773, pp. 993–997.
- Parkhurst, JO & Ssengooba, F 2009, 'Assessing access barriers to maternal health care: measuring bypassing to identify health centre needs in rural Uganda', *Health policy and planning*, vol. 24, no. 5, pp. 377–384.

- Pedrana, A, Tholandi, M, Qomariyah, SN, Sethi, R, Hyre, A, Amelia, D, Suhowatsky, S & Ahmed, S 2019, 'Presence of doctors and obstetrician/gynecologists for patients with maternal complications in hospitals in six provinces of Indonesia', *International Journal of Gynecology & Obstetrics*, vol. 144, pp. 42–50.
- Penn-Kekana, L, McPake, B & Parkhurst, J 2007, 'Improving Maternal Health: Getting What Works To Happen', *Reproductive Health Matters*, vol. 15, no. 30, pp. 28–37.
- Pettitt, DJ, Knowler, WC, Baird, HR & Bennett, PH 1980, 'Gestational diabetes: infant and maternal complications of pregnancy in relation to third-trimester glucose tolerance in the Pima Indians', *Diabetes Care*, vol. 3, no. 3, pp. 458–464.
- Phoxay, C, Okumura, J, Nakamura, Y & Wakai, S 2001, 'Influence of women's knowledge on maternal health care utilization in southern Laos', *Asia pacific journal of public health*, vol. 13, no. 1, pp. 13–19.
- Pinto, R, Masaki, E & Harimurti, P 2016, *Indonesia Health Financing System Assessment: Spend More, Spend Right, Spend Better*, World Bank, accessed April 1, 2020, from <<https://openknowledge.worldbank.org/bitstream/handle/10986/26311/112931-WP-P154841-PUBLIC.pdf?sequence=1>>.
- PKMK UGM, S 2019, 'Data utilisasi BPJS Kesehatan', *Visualisasi utilisation layanan rujukan*, accessed October 18, 2020, from <<http://kebijakankesehatanindonesia.net/datakesehatan/index.php/component/content/article/84-data-kesehatan/90-data-utilisasi-bpjs-kesehatan>>.
- Poirier, MJP, Grépin, KA & Grignon, M 2020, 'Approaches and Alternatives to the Wealth Index to Measure Socioeconomic Status Using Survey Data: A Critical Interpretive Synthesis', *Social Indicators Research*, vol. 148, no. 1, pp. 1–46.
- Prata, N, Gessesew, A, Cartwright, A & Fraser, A 2011, 'Provision of injectable contraceptives in Ethiopia through community-based reproductive health agents', *Bulletin of the World Health Organization*, vol. 89, pp. 556–564.
- Prayitna, RGI, Nurhaeni, IDA & Demartoto, AGI 2018, 'Evaluasi Program Keluarga Harapan dalam Meningkatkan Keberdayaan Perempuan di Bidang Pendidikan Dan Kesehatan', *Spirit Publik: Jurnal Administrasi Publik*, vol. 13, no. 1, pp. 67–78.
- Prendergast, AJ 2015, 'Malnutrition and vaccination in developing countries', *Philosophical Transactions of the Royal Society B: Biological Sciences*, vol. 370, no. 1671, p. 20140141.

- Prin, M, Kadyaudzu, C, Aagaard, K & Charles, A 2019, 'Obstetric admissions and outcomes in an intensive care unit in Malawi', *International journal of obstetric anesthesia*, vol. 39, pp. 99–104.
- Pujihartati, SH, Demartoto, A & Wijaya, M 2019, *Implementation of Maternity Waiting Home in Wonogiri, Indonesia*, Social Science Research Network, Rochester, NY, accessed October 16, 2020, from <<https://papers.ssrn.com/abstract=3482274>>.
- Pullum, TW 2006, *An assessment of age and date reporting in the DHS Surveys, 1985-2003*, Macro International Calverton, MD.
- Pulok, MH, Uddin, J, Enemark, U & Hossin, MZ 2018, 'Socioeconomic inequality in maternal healthcare: An analysis of regional variation in Bangladesh', *Health & Place*, vol. 52, pp. 205–214.
- Putri, NN 2016, 'EVALUASI PROGRAM KELUARGA HARAPAN (PKH) DI DESA LUNDO KECAMATAN BENJENG KABUPATEN GRESIK', *Publika*, vol. 4, no. 8, accessed October 2, 2020, from <<https://jurnalmahasiswa.unesa.ac.id/index.php/publika/article/view/16389>>.
- Qin, VM, Hone, T, Millett, C, Moreno-Serra, R, McPake, B, Atun, R & Lee, JT 2019, 'The impact of user charges on health outcomes in low-income and middle-income countries: a systematic review', *BMJ Global health*, vol. 3, no. Suppl 3.
- Quality of Care Network 2020, 'Quality of Care Network', accessed August 10, 2020, from <<http://www.qualityofcarenetwork.org/about>>.
- Radito, T 2014, 'Analisis pengaruh kualitas pelayanan dan fasilitas kesehatan terhadap kepuasan pasien Puskesmas', *Jurnal Ilmu Manajemen*, vol. 11, no. 2, pp. 1–25.
- Radovich, E, Benova, L, Penn-Kekana, L, Wong, K & Campbell, OMR 2019, '“Who assisted with the delivery of (NAME)?” Issues in estimating skilled birth attendant coverage through population-based surveys and implications for improving global tracking', *BMJ global health*, vol. 4, no. 2, p. e001367.
- Rahayu, S & Indiati, R 2017, 'Pengaruh Kualitas Pemeriksaan Kehamilan oleh Bidan Terhadap Kepuasan Ibu Hamil di PUSkesmas Brangsong I Kabupaten Kendal', *Bidan Prada: Jurnal Publikasi Kebidanan Akbid YLPP Purwokerto*, vol. 8, no. 2.
- Rajan, VS, Patil, A, Pambudi, ES & Junedi, B 2018, *Is Indonesia Ready to Serve? : An analysis of Indonesia's primary health care supply-side readiness*, World Bank, Washington, D.C. : World Bank Group, accessed March 20, 2019, from <<http://documents.worldbank.org/curated/en/484351538653658243/Is-Indonesia->

Ready-to-Serve-An-Analysis-of-Indonesia-s-Primary-Health-Care-Supply-Side-Readiness>.

- Randive, BB, Chaturvedi, SD, Diwan, V & De Costa, A 2013, 'Effective coverage of institutional deliveries under the Janani Suraksha Yojana programme in high maternal mortality provinces of India: analysis of data from an annual health survey', *The Lancet*, vol. 381, p. S123.
- Raven, JH, Tolhurst, RJ, Tang, S & van den Broek, N 2012, 'What is quality in maternal and neonatal health care?', *Midwifery*, vol. 28, no. 5, pp. e676–e683.
- Ravit, M, Ravalihasy, A, Audibert, M, Ridde, V, Bonnet, E, Raffalli, B, Roy, F-A, N'Landu, A & Dumont, A 2020, 'The impact of the obstetrical risk insurance scheme in Mauritania on maternal healthcare utilization: a propensity score matching analysis', *Health Policy and Planning*, vol. 35, no. 4, pp. 388–398.
- Republic of Indonesia 2009, *Law no. 36 on health*, accessed October 16, 2020, from <<https://peraturan.bpk.go.id/Home/Details/38778/uu-no-36-tahun-2009>>.
- Richards, E, Theobald, S, George, A, Kim, JC, Rudert, C, Jehan, K & Tolhurst, R 2013, 'Going beyond the surface: Gendered intra-household bargaining as a social determinant of child health and nutrition in low and middle income countries', *Social Science & Medicine*, vol. 95, pp. 24–33.
- Rizkianti, A, Afifah, T, Saptarini, I & Rakhmadi, MF 2020, 'Women's decision-making autonomy in the household and the use of maternal health services: An Indonesian case study', *Midwifery*, vol. 90, p. 102816.
- Roberts, M, Hsiao, W, Berman, P & Reich, M 2003, *Getting health reform right: a guide to improving performance and equity*, Oxford university press.
- Roemer, MI 1993, *National health systems of the world*, oxford university press.
- Rokx, C 2010, *New insights into the provision of health services in Indonesia: A health workforce study*, World Bank Publications, accessed from <<http://documents1.worldbank.org/curated/en/799111468038325818/pdf/538830PUB0Heal101Official0Use0Only1.pdf>>.
- Ronsmans, C 2001, 'How can we monitor progress towards improved maternal health', *Safe motherhood strategies: a review of the evidence*.
- Ronsmans, C, Etard, JF, Walraven, G, Høj, L, Dumont, A, Bernis, L de & Kodio, B 2003, 'Maternal mortality and access to obstetric services in West Africa', *Tropical Medicine & International Health*, vol. 8, no. 10, pp. 940–948.

- Ronsmans, C, Graham, WJ, & Lancet Maternal Survival Series steering group 2006, 'Maternal mortality: who, when, where, and why', *The lancet*, vol. 368, no. 9542, pp. 1189–1200.
- Rotheram-Borus, MJ, Le Roux, IM, Tomlinson, M, Mbewu, N, Comulada, WS, Le Roux, K, Stewart, J, O'Connor, MJ, Hartley, M & Desmond, K 2011, 'Philani Plus (+): a Mentor Mother community health worker home visiting program to improve maternal and infants' outcomes', *Prevention Science*, vol. 12, no. 4, pp. 372–388.
- Roy, L, Biswas, TK & Chowdhury, ME 2017, 'Emergency obstetric and newborn care signal functions in public and private facilities in Bangladesh', *PloS one*, vol. 12, no. 11, p. e0187238.
- Rudan, I, O'Brien, KL, Nair, H, Liu, L, Theodoratou, E, Qazi, S, Lukšić, I, Walker, CLF, Black, RE & Campbell, H 2013, 'Epidemiology and etiology of childhood pneumonia in 2010: estimates of incidence, severe morbidity, mortality, underlying risk factors and causative pathogens for 192 countries', *Journal of global health*, vol. 3, no. 1.
- Ruktanonchai, CW, Ruktanonchai, NW, Nove, A, Lopes, S, Pezzulo, C, Bosco, C, Alegana, VA, Burgert, CR, Ayiko, R & Charles, AS 2016, 'Equality in maternal and newborn health: modelling geographic disparities in utilisation of care in five East African countries', *PloS One*, vol. 11, no. 8, p. e0162006.
- Rupani, MP, Gaonkar, NT & Bhatt, GS 2016, 'Bottleneck analysis and strategic planning using Tanahashi model for childhood diarrhea management in Gujarat, Western India', *Evaluation and program planning*, vol. 58, pp. 82–87.
- Rutstein, S & Johnson, K 2004, *The DHS wealth index. DHS Comparative Reports No. 6*, ORC Macro, Calverton (MD), accessed from <<http://www.dhsprogram.com/publications/publicationcr6-comparative-reports.cfm>>.
- Salam, MRS, Jati, SP & Nugraheni, SA 2017, 'Analisis Pemanfaatan Pelayanan Pertolongan Persalinan Non Tenaga Kesehatan oleh Ibu Bersalin di Kabupaten Kolaka Timur (Studi Kasus di Puskesmas Ueesi)', *Jurnal Manajemen Kesehatan Indonesia*, vol. 5, no. 1, pp. 62–72.
- Saleem, AF, Mach, O, Quadri, F, Khan, A, Bhatti, Z, ur Rehman, N, Zaidi, S, Weldon, WC, Oberste, SM & Salama, M 2015, 'Immunogenicity of poliovirus vaccines in chronically malnourished infants: a randomized controlled trial in Pakistan', *Vaccine*, vol. 33, no. 24, pp. 2757–2763.

- Sari, ID, Hendarwan, H & Halim, R 2019, 'The evaluation of Nusantara Sehat program using Nusantara Sehat Public Health Index', *Health Science Journal of Indonesia*, vol. 10, no. 1, pp. 41–50.
- Sarpong, N, Loag, W, Fobil, J, Meyer, CG, Adu-Sarkodie, Y, May, J & Schwarz, NG 2010, 'National health insurance coverage and socio-economic status in a rural district of Ghana', *Tropical medicine & international health*, vol. 15, no. 2, pp. 191–197.
- Say, L & Chou, D 2011, 'Better understanding of maternal deaths—the new WHO cause classification system', *BJOG-an International Journal of Obstetrics and Gynaecology*, vol. 118, no. 2, p. 15.
- Say, L, Chou, D, Gemmill, A, Tunçalp, Ö, Moller, A-B, Daniels, J, Gülmezoglu, AM, Temmerman, M & Alkema, L 2014, 'Global causes of maternal death: a WHO systematic analysis', *The Lancet Global Health*, vol. 2, no. 6, pp. e323–e333.
- Say, L, Pattinson, RC & Gülmezoglu, AM 2004, 'WHO systematic review of maternal morbidity and mortality: the prevalence of severe acute maternal morbidity (near miss)', *Reproductive Health*, vol. 1, no. 1, p. 3.
- Say, L & Raine, R 2007, 'A systematic review of inequalities in the use of maternal health care in developing countries: examining the scale of the problem and the importance of context', *Bulletin of the World Health Organization*, vol. 85, pp. 812–819.
- Schutte, JM, de Jonge, L, Schuitemaker, NW, Santema, JG, Steegers, EA & van Roosmalen, J 2010, 'Indirect maternal mortality increases in the Netherlands', *Acta obstetrica et gynecologica Scandinavica*, vol. 89, no. 6, pp. 762–768.
- Schwarz, D, Duong, D, Adam, C, Awoonor-Williams, J, Back, D, Bang, A, Bang, R, Beebe, M, Bhatt, S & Campbell, J 2020, 'Primary Care 2030: Creating an Enabling Ecosystem for Disruptive Primary Care Models to Achieve Universal Health Coverage in Low-and Middle-Income Countries', *Annals of Global Health*, vol. 86, no. 1.
- Senarath, U & Gunawardena, NS 2009, 'Women's Autonomy in Decision Making for Health Care in South Asia', *Asia Pacific Journal of Public Health*, vol. 21, no. 2, pp. 137–143.
- Shankar, A, Sebayang, S, Guarenti, L, Utomo, B, Islam, M, Fauveau, V & Jalal, F 2008, 'The village-based midwife programme in Indonesia', *The Lancet*, vol. 371, no. 9620, pp. 1226–1229.
- Shengelia, B, Tandon, A, Adams, O & Murray, C 2005, 'Access, utilization, quality, and effective coverage: an integrated conceptual framework and measurement strategy.', *Social science & medicine (1982)*, vol. 61, no. 1, p. 97.

- Shibre, G, Zegeye, B, Ahinkorah, BO, Keetile, M & Yaya, S 2020, 'Magnitude and trends in socio-economic and geographic inequality in access to birth by cesarean section in Tanzania: evidence from five rounds of Tanzania demographic and health surveys (1996–2015)', *Archives of Public Health*, vol. 78, no. 1, pp. 1–10.
- Shiffman, J 2007, 'Generating political priority for maternal mortality reduction in 5 developing countries', *American journal of public health*, vol. 97, no. 5, pp. 796–803.
- Shrestha, R 2010, 'The village midwife program and infant mortality in Indonesia', *Bulletin of Indonesian Economic Studies*, vol. 46, no. 2, pp. 193–211.
- Simms, C & Rowson, M 2003, 'Reassessment of health effects of the Indonesian economic crisis: donors versus the data', *The Lancet*, vol. 361, no. 9366, pp. 1382–1385.
- Singh-Manoux, A, Clarke, P & Marmot, M 2002, 'Multiple measures of socio-economic position and psychosocial health: proximal and distal measures', *International Journal of Epidemiology*, vol. 31, no. 6, pp. 1192–1199.
- Sitepu, A 2019, 'Jejak 3 Tahun Pencerah Nusantara', accessed October 16, 2020, from <<https://docplayer.info/147429681-Jejak-3-tahun-pencerah-nusantara.html>>.
- Situmorang, A 2003, 'Adolescent reproductive health in Indonesia', *Jakarta: STARH Program*.
- Smith, SM, Soubhi, H, Fortin, M, Hudon, C & O'Dowd, T 2012, 'Managing patients with multimorbidity: systematic review of interventions in primary care and community settings', *Bmj*, vol. 345, p. e5205.
- Smyth, I 1991, 'The Indonesian family planning programme: a success story for women?', *Development and Change*, vol. 22, no. 4, pp. 781–805.
- Sobhy, S 2017, 'Risks of adverse maternal and perinatal outcomes in low and middle-income countries (LMIC): Systematic reviews and meta-analyses of evidence',.
- Sochas, L 2020, 'The predictive power of health system environments: a novel approach for explaining inequalities in access to maternal healthcare', *BMJ global health*, vol. 4, no. Suppl 5.
- Sparrow, R, Suryahadi, A & Widyanti, W 2013, 'Social health insurance for the poor: Targeting and impact of Indonesia's Askeskin programme', *Social science & medicine*, vol. 96, pp. 264–271.
- Sparrow, R & Vothknecht, M 2011, *Report on infrastructure supply readiness in Indonesia- achievements and remaining gaps*, Tech. rep., Coordinating Ministry for People's Welfare in cooperation with

- Stallings-Smith, S, Zeka, A, Goodman, P, Kabir, Z & Clancy, L 2013, 'Reductions in Cardiovascular, Cerebrovascular, and Respiratory Mortality following the National Irish Smoking Ban: Interrupted Time-Series Analysis', *PLoS ONE*, vol. 8, no. 4, accessed April 1, 2020, from <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3634756/>>.
- Stanton, CK, Rawlins, B, Drake, M, Dos Anjos, M, Cantor, D, Chongo, L, Chavane, L, da Luz Vaz, M & Ricca, J 2013, 'Measuring coverage in MNCH: testing the validity of women's self-report of key maternal and newborn health interventions during the peripartum period in Mozambique', *PloS one*, vol. 8, no. 5, p. e60694.
- Strauss, J, Witoelar, F & Sikoki, B 2016, *The Fifth Wave of the Indonesia Family Life Survey: Overview and Field Report: Volume 1*, RAND Corporation, accessed February 25, 2020, from <http://www.rand.org/pubs/working_papers/WR1143z1.html>.
- Streatfield, PK, Alam, N, Compaoré, Y, Rossier, C, Soura, AB, Bonfoh, B, Jaeger, F, Ngoran, EK, Utzinger, J & Gomez, P 2014, 'Pregnancy-related mortality in Africa and Asia: evidence from INDEPTH Health and Demographic Surveillance System sites', *Global health action*, vol. 7, no. 1, p. 25368.
- SUMMIT Study Group, S with MMIT (SUMMIT) SG 2008, 'Effect of maternal multiple micronutrient supplementation on fetal loss and infant death in Indonesia: a double-blind cluster-randomised trial', *The Lancet*, vol. 371, no. 9608, pp. 215–227.
- Syah, NA 2019, 'General Practitioners' Autonomy in the Management of Non-Communicable Diseases (NCDs) in the JKN Era: Is It Feasible?', *Review of Primary Care Practice and Education*, vol. 2, no. 3, pp. 89–91.
- Szwarcwald, CL, Souza Júnior, PRB de, Marques, AP, Almeida, W da S de & Montilla, DER 2016, 'Inequalities in healthy life expectancy by Brazilian geographic regions: findings from the National Health Survey, 2013', *International Journal for Equity in Health*, vol. 15, no. 1, p. 141.
- Tarekegn, SM, Lieberman, LS & Giedraitis, V 2014, 'Determinants of maternal health service utilization in Ethiopia: analysis of the 2011 Ethiopian Demographic and Health Survey', *BMC pregnancy and childbirth*, vol. 14, no. 1, p. 161.
- Tembo, T, Chongwe, G, Vwalika, B & Sitali, L 2017, 'Signal functions for emergency obstetric care as an intervention for reducing maternal mortality: a survey of public and private health facilities in Lusaka District, Zambia', *BMC Pregnancy and Childbirth*, vol. 17, no. 1, p. 288.
- Teplitskaya, L & Dutta, A 2018, *Has Indonesia's National Health Insurance Scheme Improved Access to Maternal and Newborn Health Services?*, Health Policy Plus, accessed from

<http://www.healthpolicyplus.com/ns/pubs/8226-9416_HPPlusIndonesiaJKNAccesstoMNHservices.pdf>.

- Thaddeus, S & Maine, D 1994, 'Too far to walk: maternal mortality in context', *Social science & medicine*, vol. 38, no. 8, pp. 1091–1110.
- Titaley, C, Dibley, M & Roberts, C 2009, 'Factors associated with non-utilisation of postnatal care services in Indonesia', *Journal of Epidemiology and Community Health*, vol. 63, no. 10, pp. 827–831.
- Titaley, CR, Dibley, MJ, Agho, K, Roberts, CL & Hall, J 2008, 'Determinants of neonatal mortality in Indonesia', *BMC Public Health*, vol. 8, no. 1, p. 232.
- Titaley, CR, Dibley, MJ & Roberts, CL 2010, 'Factors associated with underutilization of antenatal care services in Indonesia: results of Indonesia Demographic and Health Survey 2002/2003 and 2007', *BMC Public Health*, vol. 10, no. 1, p. 1.
- Titaley, CR, Dibley, MJ & Roberts, CL 2011, 'Utilization of village midwives and other trained delivery attendants for home deliveries in Indonesia: results of Indonesia Demographic and Health Survey 2002/2003 and 2007', *Maternal and child health journal*, vol. 15, no. 8, pp. 1400–1415.
- Titaley, CR, Hunter, CL, Dibley, MJ & Heywood, P 2010, 'Why do some women still prefer traditional birth attendants and home delivery?: a qualitative study on delivery care services in West Java Province, Indonesia', *BMC Pregnancy and Childbirth*, vol. 10, no. 1, p. 43.
- Tripathi, V & Singh, R 2017, 'Regional differences in usage of antenatal care and safe delivery services in Indonesia: findings from a nationally representative survey', *BMJ Open*, vol. 7, no. 2, p. e013408.
- Trisnantoro, L, Hendrartini, J, Susilowati, T, Miranti, PAD & Aristianti, V 2016, 'A critical analysis of selected healthcare purchasing mechanisms in Indonesia', *Strategic Purchasing in China, Indonesia and the Philippines. Asia Pacific Observatory on Health Systems and Policies in World Health Organization*, pp. 96–151.
- Trisnantoro, L, Marthias, T, Djasri, H, Candra, Hasri, ET, Kurniawan, MF, Rahma, PA, Fanda, RB & Aktariyani, T 2020, *Laporan hasil penelitian evaluasi kebijakan JKN di 13 provinsi Indonesia*, PKMK FKMK Universitas Gadjadh Mada, Knowledge Sector Initiative (KSI), Yogyakarta, Indonesia, accessed July 15, 2020, from <<https://kebijakankesehatanindonesia.net/datakesehatan/file/Laporan-evaluasi-kebijakan-JKN-2020.pdf>>.

- Tsegay, Y, Gebrehiwot, T, Goicolea, I, Edin, K, Lemma, H & Sebastian, MS 2013, 'Determinants of antenatal and delivery care utilization in Tigray region, Ethiopia: a cross-sectional study', *International Journal for Equity in Health*, vol. 12, no. 1, p. 30.
- Tunçalp, Ö., Were, W, MacLennan, C, Oladapo, O, Gülmezoglu, A, Bahl, R, Daelmans, B, Mathai, M, Say, L, Kristensen, F, Temmerman, M & Bustreo, F 2015, 'Quality of care for pregnant women and newborns—the WHO vision', *Bjog*, vol. 122, no. 8, pp. 1045–1049.
- Tura, G, Fantahun, M & Worku, A 2013, 'The effect of health facility delivery on neonatal mortality: systematic review and meta-analysis', *BMC Pregnancy and Childbirth*, vol. 13, no. 1, p. 18.
- UN IGME 2020, 'Neonatal mortality', *UNICEF DATA*, accessed September 11, 2020, from <<https://data.unicef.org/topic/child-survival/neonatal-mortality/>>.
- UNFPA 2014, *JAMPERSAL Review 2103: Collaborative Study for Ten Indonesian Districts*, UNFPA, Jakarta, Indonesia, accessed September 25, 2020, from <<https://indonesia.unfpa.org/en/publications/jampersal-review-2103-collaborative-study-ten-indonesian-districts>>.
- UNICEF 2020, 'Delivery care', *UNICEF DATA*, accessed August 6, 2020, from <<https://data.unicef.org/topic/maternal-health/delivery-care/>>.
- UNICEF, World Health Organization & World Bank 2019, 'Prevalence of stunting, height for age (% of children under 5) - Indonesia', *UNICEF, WHO, World Bank: Joint child malnutrition estimates (JME) Prevalence of stunting, height for age (% of children under 5) - Indonesia*, accessed September 12, 2020, from <<https://data.worldbank.org/indicator/SH.STA.STNT.ZS?locations=ID>>.
- United Nation 2015, *The Millennium Development Goals Report 2015*,.
- United Nations 2015, *Goal 3: Ensure health lives and promote well-being for all at all ages*, New York, accessed September 22, 2020, from <<https://www.un.org/sustainabledevelopment/health/>>.
- United Nations 2016a, 'The Millennium Development Goals Report 2015', accessed from <http://www.undp.org/content/dam/undp/library/MDG/english/UNDP_MDG_Report_2015.pdf>.
- United Nations 2016b, *Transforming our world: The 2030 agenda for sustainable development*, United Nations, New York, accessed April 1, 2020, from <http://wedocs.unep.org/bitstream/handle/20.500.11822/11125/unep_swio_sm1_inf7_sdg.pdf?sequence=1>.

- United Nations IGME 2020, *Child Mortality*, United Nations Inter-agency Group for Child Mortality Estimation, accessed September 10, 2020, from <<https://data.unicef.org/topic/child-survival/under-five-mortality/>>.
- Universitas Gadjah Mada 2020, 'Human Resource Skill Mix And Task Shifting In Indonesian Health System', *Kanal Pengetahuan FKMK UGM*, accessed September 24, 2020, from <<https://kanalpengetahuan.fk.ugm.ac.id/human-resource-skill-mix-and-task-shifting-in-indonesian-health-system/>>.
- Van Doorslaer, E, Wagstaff, A, Bleichrodt, H, Calonge, S, Gerdtham, U-G, Gerfin, M, Geurts, J, Gross, L, Häkkinen, U & Leu, RE 1997, 'Income-related inequalities in health: some international comparisons', *Journal of health economics*, vol. 16, no. 1, pp. 93–112.
- Vellakkal, S, Reddy, H, Gupta, A, Chandran, A, Fledderjohann, J & Stuckler, D 2017, 'A qualitative study of factors impacting accessing of institutional delivery care in the context of India's cash incentive program', *Social Science & Medicine*, vol. 178, pp. 55–65.
- Vernon, R 2009, 'Nurse auxiliaries as providers of intrauterine devices for contraception in Guatemala and Honduras', *Reproductive Health Matters*, vol. 17, no. 33, pp. 51–60.
- Victora, CG 2008, 'The millennium development goals and the inverse care law: no progress where it is most needed?', *Journal of Epidemiology & Community Health*, vol. 62, no. 11, pp. 938–939.
- Victora, CG, Vaughan, JP, Barros, FC, Silva, AC & Tomasi, E 2000, 'Explaining trends in inequities: evidence from Brazilian child health studies', *The Lancet*, vol. 356, no. 9235, pp. 1093–1098.
- Vidler, M, Ramadurg, U, Charantimath, U, Katageri, G, Karadiguddi, C, Sawchuck, D, Qureshi, R, Dharamsi, S, Joshi, A, von Dadelszen, P, Derman, R, Bellad, M, Goudar, S, Mallapur, A, & for the Community Level Interventions for Pre-eclampsia (CLIP) India Feasibility Working Group 2016, 'Utilization of maternal health care services and their determinants in Karnataka State, India', *Reproductive Health*, vol. 13, no. 1, p. 37.
- Vidyattama, Y, Miranti, R & Resosudarmo, BP 2014, 'The role of health insurance membership in health service utilisation in Indonesia', *Bulletin of Indonesian Economic Studies*, vol. 50, no. 3, pp. 393–413.
- Viegas Andrade, M, Noronha, K, Singh, A, Rodrigues, CG & Padmadas, SS 2012, 'Antenatal care use in Brazil and India: Scale, outreach and socioeconomic inequality', *Health & Place*, vol. 18, no. 5, pp. 942–950.

- Wagstaff, A 2000, 'Socioeconomic inequalities in child mortality: comparisons across nine developing countries', *Bulletin of the World Health Organization*, p. 11.
- Wagstaff, A 2007, *Health insurance for the poor: initial impacts of Vietnam's health care fund for the poor*, The World Bank.
- Wall, SN, Lee, AC, Carlo, W, Goldenberg, R, Niermeyer, S, Darmstadt, GL, Keenan, W, Bhutta, ZA, Perlman, J & Lawn, JE 2010, 'Reducing intrapartum-related neonatal deaths in low-and middle-income countries—what works?', in Elsevier, pp. 395–407, accessed July 15, 2019, from <<https://www.sciencedirect.com/science/article/pii/S0146000510001096>>.
- Walt, G 2004, 'WHO's world health report 2003',.
- Wang, W, Temsah, G & Mallick, L 2017, 'The impact of health insurance on maternal health care utilization: evidence from Ghana, Indonesia and Rwanda', *Health policy and planning*, vol. 32, no. 3, pp. 366–375.
- van Weel, C & Kidd, MR 2018, 'Why strengthening primary health care is essential to achieving universal health coverage', *CMAJ*, vol. 190, no. 15, pp. E463–E466.
- Whitehead, M 1991, 'The concepts and principles of equity and health', *Health Promotion International*, vol. 6, no. 3, pp. 217–228.
- Wibulpolprasert, S 2001, 'Economic uncertainties: future challenges to world health. Lessons learned from Thailand', *In Health by the people: a celebration of the life of Ken Newell*.
- Wibulpolprasert, S & Pengpaibon, P 2003, 'Integrated strategies to tackle the inequitable distribution of doctors in Thailand: four decades of experience', *Human resources for health*, vol. 1, no. 1, pp. 1–17.
- Widayanti, AW, Green, JA, Heydon, S & Norris, P 2020, 'Health-Seeking Behavior of People in Indonesia: A Narrative Review', *Journal of Epidemiology and Global Health*, vol. 10, no. 1, pp. 6–15.
- Wijayanti, HN 2015, 'Hubungan Tingkat Kepercayaan Ibu Hamil Terhadap Kemampuan Dukun Bayi Dengan Pemilihan Jenis Tenaga Penolong Persalinan di Puskesmas Bancak Kecamatan Bancak Kabupaten Semarang', *Medika Respati: Jurnal Ilmiah Kesehatan*, vol. 10, no. 3.
- Williams, RF & Doessel, D 2006, 'Measuring inequality: tools and an illustration', *International Journal for Equity in Health*, vol. 5, no. 1, p. 5.

- Witteveen, T, Zwart, JJ, Gast, KB, Bloemenkamp, KW & van Roosmalen, J 2013, 'Overweight and severe acute maternal morbidity in a low-risk pregnant population in the Netherlands', *PloS one*, vol. 8, no. 9, p. e74494.
- World Bank 2020a, 'Population growth (annual %) - Indonesia', accessed September 13, 2020, from <<https://data.worldbank.org/indicator/SP.POP.GROW?locations=ID>>.
- World Bank 2020b, 'Urban population (% of total population) - Indonesia', accessed September 13, 2020, from <<https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=ID>>.
- World Bank 2020c, 'Mortality and health indicators - Indonesia', accessed September 13, 2020, from <<https://data.worldbank.org/indicator/>>.
- World Bank 2020d, 'Maternal mortality ratio (modeled estimate, per 100,000 live births)', accessed April 30, 2020, from <<https://data.worldbank.org/indicator/SH.STA.MMRT>>.
- World Bank 2020e, 'Mortality rate, infant (per 1,000 live births) - Indonesia | Data', accessed August 10, 2020, from <<https://data.worldbank.org/indicator/SP.DYN.IMRT.IN?locations=ID>>.
- World Bank 2020f, 'Fertility rate, total (births per woman) - Indonesia, Vietnam, Thailand, Malaysia, Philippines | Data', accessed October 16, 2020, from <<https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=ID-VN-TH-MY-PH>>.
- World Bank Group 2020a, *Indonesia Public Expenditure Review: Spending for Better Results*, World Bank, Jakarta, Indonesia, accessed September 24, 2020, from <<https://www.worldbank.org/en/country/indonesia/publication/indonesia-public-expenditure-review>>.
- World Bank Group 2020b, 'Domestic general government health expenditure (% of general government expenditure) - Indonesia | Data', accessed October 15, 2020, from <<https://data.worldbank.org/indicator/SH.XPD.GHED.GE.ZS?locations=ID>>.
- World Health Organization 2000, 'The world health report 2000 - Health systems: improving performance', *WHO*, accessed September 19, 2020, from <<https://www.who.int/whr/2000/en/>>.
- World Health Organization 2005, *The World health report: 2005: make every mother and child count*, World Health Organization.

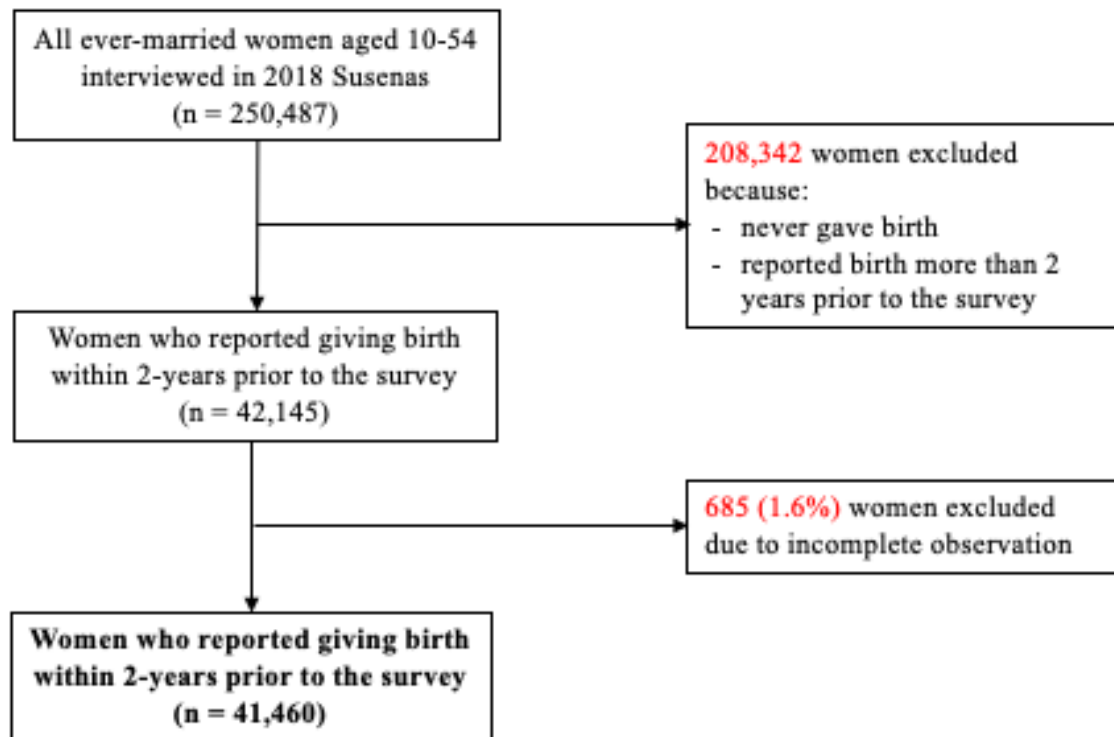
- World Health Organization 2006, *Neonatal and perinatal mortality: country, regional and global estimates*, World Health Organization.
- World Health Organization 2007, 'Everybody's business--strengthening health systems to improve health outcomes: WHO's framework for action',.
- World Health Organization 2009, 'WHO child growth standards and the identification of severe acute malnutrition in infants and children', accessed September 12, 2020, from <<http://www.who.int/childgrowth/standards/en/>>.
- World Health Organization 2010a, *Packages of interventions for family planning, safe abortion care, maternal, newborn and child health*, WHO.
- World Health Organization 2010b, *Global status report on noncommunicable diseases 2010*, World Health Organization, Geneva, Switzerland, accessed September 22, 2020, from <http://www.who.int/nmh/publications/ncd_report2010/en/>.
- World Health Organization (ed.) 2012, *The WHO application of ICD-10 to deaths during pregnancy, childbirth and the puerperium*, IDC MM, World Health Organization, Geneva.
- World Health Organization 2013, *WHO recommendations on postnatal care of the mother and newborn*, World Health Organization, Geneva, accessed July 15, 2020, from <https://apps.who.int/iris/bitstream/handle/10665/97603/9789241506649_eng.pdf?sequence=1>.
- World Health Organization 2014, 'Revised WHO classification and treatment of pneumonia in children at health facilities: evidence summaries',.
- World Health Organization 2015a, 'WHO recommendations on interventions to improve preterm birth outcomes', accessed from <https://apps.who.int/iris/bitstream/handle/10665/183037/9789241508988_eng.pdf;jsessionid=E60F5CADE8789FDD99A4269BE749E23D?sequence=1>.
- World Health Organization 2015b, *State of inequality: reproductive, maternal, newborn and child health*, World Health Organization.
- World Health Organization 2017, *State of health inequality: Indonesia*, accessed July 15, 2020, from <<https://apps.who.int/iris/bitstream/handle/10665/259685/9789241513340-eng.pdf>>.
- World Health Organization 2018, 'Definition of skilled health personnel providing care during childbirth: the 2018 joint statement by WHO',.

- World Health Organization 2019a, *Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division*, World Health Organization, Geneva, accessed March 10, 2020, from <<http://documents.worldbank.org/curated/en/793971568908763231/Trends-in-maternal-mortality-2000-to-2017-Estimates-by-WHO-UNICEF-UNFPA-World-Bank-Group-and-the-United-Nations-Population-Division>>.
- World Health Organization 2019b, 'Newborns: improving survival and well-being', accessed September 10, 2020, from <<https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality>>.
- World Health Organization 2019c, 'Daily iron and folic acid supplementation during pregnancy', *WHO*, accessed September 22, 2020, from <http://www.who.int/elena/titles/daily_iron_pregnancy/en/>.
- World Health Organization 2020a, 'Maternal mortality: situation - by country', *WHO*, accessed August 30, 2020, from <http://www.who.int/gho/maternal_health/mortality/maternal/en/>.
- World Health Organization 2020b, *World Health Statistics 2020 monitoring health for the SDGs, sustainable development goals*, World Health Organization, Geneva, accessed from <https://www.who.int/gho/publications/world_health_statistics/2020/en/>.
- World Health Organization 2020c, 'Children: improving survival and well-being', accessed September 11, 2020, from <<https://www.who.int/news-room/fact-sheets/detail/children-reducing-mortality>>.
- World Health Organization 2020d, 'Causes of child mortality', *WHO*, accessed September 11, 2020, from <http://www.who.int/gho/child_health/mortality/causes/en/>.
- World Health Organization 2020e, 'Physicians (per 1,000 people) - Indonesia, Philippines, Vietnam, Malaysia, Thailand, Low & middle income', accessed September 17, 2020, from <<https://data.worldbank.org/indicator/SH.MED.PHYS.ZS?locations=ID-PH-VN-MY-TH-XO>>.
- World Health Organization 2020f, 'Nurses and midwives (per 1,000 people) - Indonesia, Philippines, Malaysia, Thailand, Low & middle income, Vietnam', accessed September 17, 2020, from <<https://data.worldbank.org/indicator/SH.MED.NUMW.P3?locations=ID-PH-MY-TH-XO-VN>>.
- World Health Organization, Regional Office for Europe, & Meeting (eds) 1986, *Social justice and equity in health: report on a WHO Meeting, Leeds, 22-26 July, 1985.*, Regional Office for Europe, World Health Organization, Copenhagen.

- World Health Organization & World Bank Group 2014, *Monitoring progress towards universal health coverage at country and global levels*, World Health Organization, Geneva, Switzerland, accessed October 8, 2020, from <https://apps.who.int/iris/bitstream/handle/10665/112824/WHO_HIS_HIA_14.1_eng.pdf>.
- Yargawa, J & Leonardi-Bee, J 2015, 'Male involvement and maternal health outcomes: systematic review and meta-analysis', *J Epidemiol Community Health*, vol. 69, no. 6, pp. 604–612.
- Yip, WC, Wang, H & Liu, Y 1998, 'Determinants of patient choice of medical provider: a case study in rural China', *Health policy and planning*, vol. 13, no. 3, pp. 311–322.
- Zupan, J 2005, 'Perinatal mortality in developing countries', *New England Journal of Medicine*, vol. 352, no. 20, pp. 2047–2048.

Appendix 1: Supplementary materials for Manuscript 1

Manuscript 1 Appendix 1. Sample flowchart



Manuscript 1 Appendix 2. Definition of variables

Variable	Definition
Skilled birth attendance	Status of the use of skilled birth attendance for baby delivery. Dummy = 1 if reported utilising skilled birth attendant for delivery, = 0 if otherwise. Skilled birth attendant includes doctors and midwives. Non-skilled birth attendant includes “other paramedics”, traditional birth attendant, family members and others.
Maternal education level	Education attainment of the father of the under-five child. Dummy = 0 if reported having no education; 1 if graduated from primary school; 2 if graduated from lower secondary school; 3 if graduated from higher secondary school; 4 if graduated from post-secondary school.
Maternal age	Maternal age at the time of delivery Dummy = 0 if mother's age during delivery 25-35; 1 if <20 years old; 2 if between 20-25; 3 if 36 years old or above
Maternal marital status	Marital status of the mother Dummy = 0 if currently married; = 1 if otherwise
Insurance status	Coverage of health insurance of the mother. Dummy = 0 if the mother does not hold any health insurance, = 1 if otherwise
Paternal education level	Education attainment of the father of the under-five child. Dummy = 0 if reported having no education; 1 if graduated from primary school; 2 if graduated from lower secondary school; 3 if graduated from higher secondary school; 4 if graduated from post-secondary school.
Household size	Number of members in a household
Per capita household expenditure (average in USD) (in natural log)	Average per capita expenditure in a household, using 2018 mid-year exchange rate from US Dollar to Indonesian Rupiah
Type of toilet	Type of toilet used by the household. Dummy = 1 if the household uses flush toilet with septic tank, = 0 if otherwise (pond/field, river/lake/ocean, ground pit, beach/yard/bush and others)
Source of drinking water	Type of source of drinking water used by the household. Dummy = 1 if the household uses protected water sources (bottled water, refill water, metered piped water, retailed plumbing), = 0 if otherwise (boreholes, open well, protected spring, river water, rain water and others)
Urban-rural	Type of residence Dummy = 0 if rural; 1 if urban
Human resource availability	Total number of skilled birth attendants (doctors and midwives) at district level. Source: Ministry of Health registry from 201.
Hospital beds availability	Total number of hospital beds at the province level. Source: Ministry of Health database 2018
Puskesmas (primary health center) availability	Total number of Puskesmas able to provide standardized services at the province level Source: Indonesian Health Profile, 2018
Human resource availability (in natural log)	Natural log of total number of skilled birth attendants
Hospital beds availability (in natural log)	Natural log of total number of hospital beds
Puskesmas able to provide standardized services (in natural log)	Natural log of total number of Puskesmas able to provide standardized services
Regions of residence	5 region dummies (Java-Bali, Sumatera, Kalimantan, Sulawesi, Eastern Indonesia (consisting of West Nusa Tenggara, East Nusa Tenggara, Maluku and Papua island groups))

Manuscript 1 Appendix 3. Logistic regression for SBA utilization, by region

Variables	Indonesia		Java-Bali		Non Java-Bali		Sumatra		Kalimantan		Sulawesi		Eastern Indonesia*	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Maternal education level														
None	(ref)													
Primary	0.244**	(0.102)	0.396*	(0.230)	0.215**	(0.095)	0.155	(0.187)	0.459**	(0.218)	0.301	(0.186)	0.097	(0.171)
Lower secondary	0.770***	(0.111)	1.115***	(0.252)	0.516***	(0.105)	0.628***	(0.217)	0.590**	(0.237)	0.696***	(0.220)	0.245	(0.178)
Higher secondary	1.101***	(0.111)	1.416***	(0.279)	0.921***	(0.112)	1.275***	(0.236)	1.390***	(0.278)	0.747***	(0.231)	0.527***	(0.177)
Post-secondary	2.240***	(0.214)	4.133***	(0.808)	1.837***	(0.214)	3.378***	(0.557)	2.640***	(0.631)	1.218**	(0.487)	1.178***	(0.261)
Maternal age														
25-35 years old	(ref)													
< 20 years old	-0.235*	(0.133)	-0.318	(0.264)	-0.224*	(0.125)	-0.580**	(0.277)	0.424	(0.270)	-0.302	(0.221)	-0.361*	(0.199)
20-24 years old	0.087	(0.082)	0.434**	(0.193)	-0.119	(0.081)	-0.128	(0.161)	-0.215	(0.187)	0.088	(0.162)	-0.171	(0.135)
>35 years old	0.096	(0.098)	0.113	(0.207)	0.107	(0.085)	0.313*	(0.166)	0.429**	(0.211)	0.156	(0.189)	-0.246*	(0.138)
Maternal marital status														
Married	(ref)													
Not married	-0.615***	(0.222)	-1.055**	(0.423)	-0.523**	(0.236)	-0.168	(0.475)	0.623	(0.592)	-0.116	(0.709)	-1.133***	(0.311)
Insurance status														
No insurance	(ref)													
Has insurance	0.735***	(0.069)	0.881***	(0.148)	0.656***	(0.067)	0.640***	(0.129)	0.636***	(0.160)	0.713***	(0.141)	0.551***	(0.120)
Paternal education level														
None	(ref)													
Primary	0.160	(0.113)	0.342	(0.249)	0.072	(0.105)	0.097	(0.212)	0.089	(0.246)	-0.118	(0.219)	0.157	(0.189)
Lower secondary	0.418***	(0.125)	0.522*	(0.276)	0.317***	(0.111)	0.516**	(0.226)	0.276	(0.271)	0.111	(0.244)	0.148	(0.192)
Higher secondary	0.583***	(0.124)	1.023***	(0.303)	0.376***	(0.119)	0.343	(0.246)	0.230	(0.278)	0.229	(0.242)	0.711***	(0.188)
Post-secondary	0.514**	(0.206)	0.731	(0.549)	0.435**	(0.198)	0.040	(0.437)	0.287	(0.488)	0.398	(0.455)	0.926***	(0.277)
Household size (average)	-0.014	(0.019)	-0.016	(0.044)	0.005	(0.019)	0.011	(0.038)	0.051	(0.048)	0.061	(0.050)	-0.036	(0.028)
Per capita household expenditure (ln) (USD)	0.104*	(0.060)	0.050	(0.112)	0.200***	(0.058)	0.194	(0.128)	0.401***	(0.141)	0.248**	(0.106)	0.013	(0.105)
Stool disposal														
Pit and others	(ref)													
Flush toilet	0.805***	(0.079)	0.852***	(0.167)	0.782***	(0.071)	0.924***	(0.151)	0.781***	(0.184)	0.692***	(0.145)	0.848***	(0.120)
Source of drinking water														
Unprotected source	(ref)													
Protected source	0.556***	(0.078)	0.311*	(0.175)	0.752***	(0.076)	0.919***	(0.142)	0.703***	(0.183)	0.890***	(0.149)	0.426***	(0.136)
Urban														
Rural	(ref)													
Urban	0.678***	(0.117)	0.860***	(0.213)	0.593***	(0.112)	0.866***	(0.244)	0.544**	(0.270)	0.265	(0.228)	0.407**	(0.185)
Human resource (SBA) (ln of absolute number)	0.208***	(0.050)	1.165***	(0.210)	0.537***	(0.049)	0.240**	(0.101)	0.392**	(0.159)	-0.032	(0.150)	0.531***	(0.090)
Hospital beds (ln of absolute number)	0.048	(0.078)	1.430***	(0.273)	0.226**	(0.093)	-0.101	(0.302)	-0.151	(0.333)	-0.079	(0.191)	0.853***	(0.147)
Puskesmas providing standard services (ln absolute number)	0.239***	(0.081)	-0.701***	(0.250)	0.077	(0.089)	-0.189	(0.329)	0.527	(0.353)	0.524***	(0.182)	-0.026	(0.140)
Number of observations	41,460		11,080		30,380		12,452		4,219		6,041		7,668	

*includes regions of Nusa Tenggara, Maluku and Papua; standard errors are in parenthesis and weighted to reflect the complex survey design. ***p<0.01, **p<0.05,

*p<0.1.

Manuscript 1 Appendix 4. Decomposition of SBA use gaps between Java-Bali and other regions (using Java-Bali coefficient weights)

Decomposition estimates	Java-Bali vs the rest of Indonesia		Java-Bali vs Sumatra		Java-Bali vs. Kalimantan		Java-Bali vs. Sulawesi		Java-Bali vs. Eastern Indonesia	
	Coef.	(%)	Coef.	(%)	Coef.	(%)	Coef.	(%)	Coef.	(%)
Maternal education	0.010***	13.7	0.005***	7.1	0.012***	20.3	0.012***	20.8	0.016***	7.9
Maternal age	0.000	0.2	0.000	0.3	0.000	0.8	0.000	0.0	0.000	-0.1
Maternal marital status	0.001*	0.7	0.000*	0.4	0.000	0.5	0.000	0.4	0.001*	0.6
Maternal insurance status	-0.001	-1.1	0.000	-0.1	0.003***	5.4	-0.004***	-7.7	-0.001*	-0.6
Paternal education	0.002*	3.0	0.000	0.4	0.003**	4.8	0.003*	4.8	0.005**	2.6
Household size (average)	0.001	1.1	0.000	0.6	0.000	0.6	0.001	1.1	0.002	0.9
Per capita household expenditure (ln) (USD)	0.000	-0.1	0.000	0.0	0.000	0.3	0.000	-0.3	0.000	-0.2
Flush toilet	0.003***	4.1	0.003***	3.6	0.003***	5.6	0.001	0.9	0.006***	3.0
Protected drinking water	0.002	3.0	0.002	2.1	0.003	4.8	0.001	2.2	0.004	2.1
Urban-rural	0.008***	10.3	0.006***	8.2	0.006***	10.7	0.007***	12.4	0.012***	6.1
Human resource (SBA) (ln of absolute number)	-0.032***	-43.1	-0.018***	-23.7	-0.038***	-62.3	-0.033***	-56.4	-0.055***	-27.3
Hospital beds (ln of absolute number)	0.029	39.7	0.024	31.8	0.038	62.7	0.028	47.9	0.037	18.3
Puskesmas able to provide standardized service (ln of absolute number)	0.007	10.1	0.005	6.8	0.010	17.2	0.006	10.9	0.011	5.6
Total explained	0.031	41.7	0.028	37.4	0.043	71.4	0.021	37.0	0.038	18.9
Total unexplained		58.3		62.6		28.6		63.0		81.1
Difference	0.074		0.019		0.060		0.058		0.201	

***p<0.01, **p<0.05, *p<0.1.

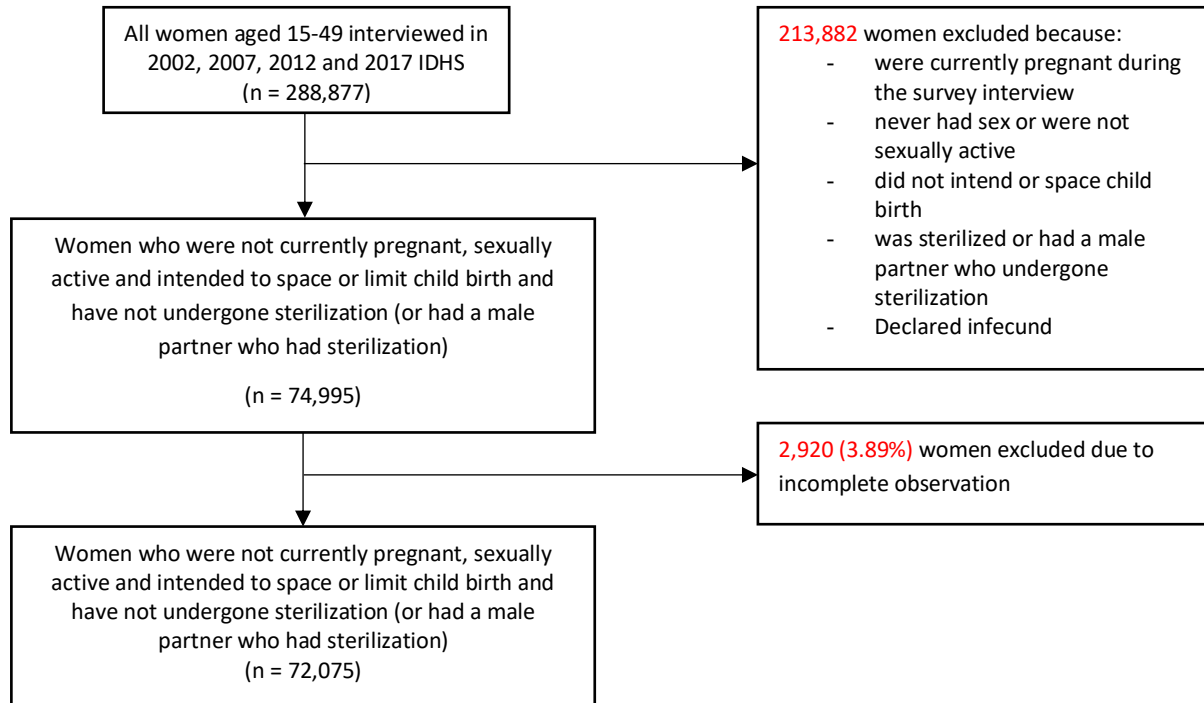
Manuscript 1 Appendix 5. Decomposition of SBA use gaps between Java-Bali and other regions (using other region coefficient weights)

Decomposition estimates	Java-Bali vs the rest of Indonesia		Java-Bali vs Sumatra		Java-Bali vs. Kalimantan		Java-Bali vs. Sulawesi		Java-Bali vs. Eastern Indonesia	
	Coef.	(%)	Coef.	(%)	Coef.	(%)	Coef.	(%)	Coef.	(%)
Maternal education	0.005***	6.7	0.004***	5.8	0.009***	14.6	0.008***	14.3	0.009***	4.7
Maternal age	0.000	-0.1	-0.001**	-1.6	-0.001	-1.2	0.000	0.4	0.000	0.2
Maternal marital status	0.000**	0.4	0.000	0.0	0.000	0.2	0.000	0.0	0.001**	0.6
Maternal insurance status	0.000	0.0	0.001***	1.3	0.003***	5.5	-0.003***	-6.1	0.000*	-0.2
Paternal education	0.000	0.5	0.001	0.9	0.000	-0.7	0.000	0.4	-0.001	-0.3
Household size (average)	0.000	0.3	0.000	-0.4	0.000	-0.3	-0.001	-1.0	0.001	0.7
Per capita household expenditure (ln) (USD)	0.000***	0.2	-0.001*	-0.9	-0.002	-3.1	0.001*	1.3	-0.001	-0.3
Flush toilet	0.003***	3.6	0.004***	5.8	0.003***	4.8	0.001***	1.9	0.006***	2.7
Protected drinking water	0.005***	7.3	0.006***	8.1	0.007***	11.9	0.005***	9.5	0.009***	4.4
Urban-rural	0.004***	5.4	0.004***	5.2	0.003**	5.3	0.006**	10.4	0.007***	3.5
Human resource (SBA) (ln of absolute number)	0.026***	34.6	0.004	5.6	0.016*	26.8	-0.002	-3.1	0.051***	25.1
Hospital beds (ln of absolute number)	0.033***	45.0	-0.020	-26.8	-0.033	-54.6	-0.017	-30.1	0.186***	92.5
Puskesmas able to provide standardized service (ln of absolute number)	0.010	12.9	0.002	2.1	0.054**	89.2	0.042***	72.8	-0.062*	-30.6
Total explained	0.087	116.9	0.000	4.8	0.059	98.4	0.041	70.8	0.207	102.9
Total unexplained		-16.9		95.2		1.6		29.2		-2.9
Difference	0.156		0.000		0.060		0.058		0.201	

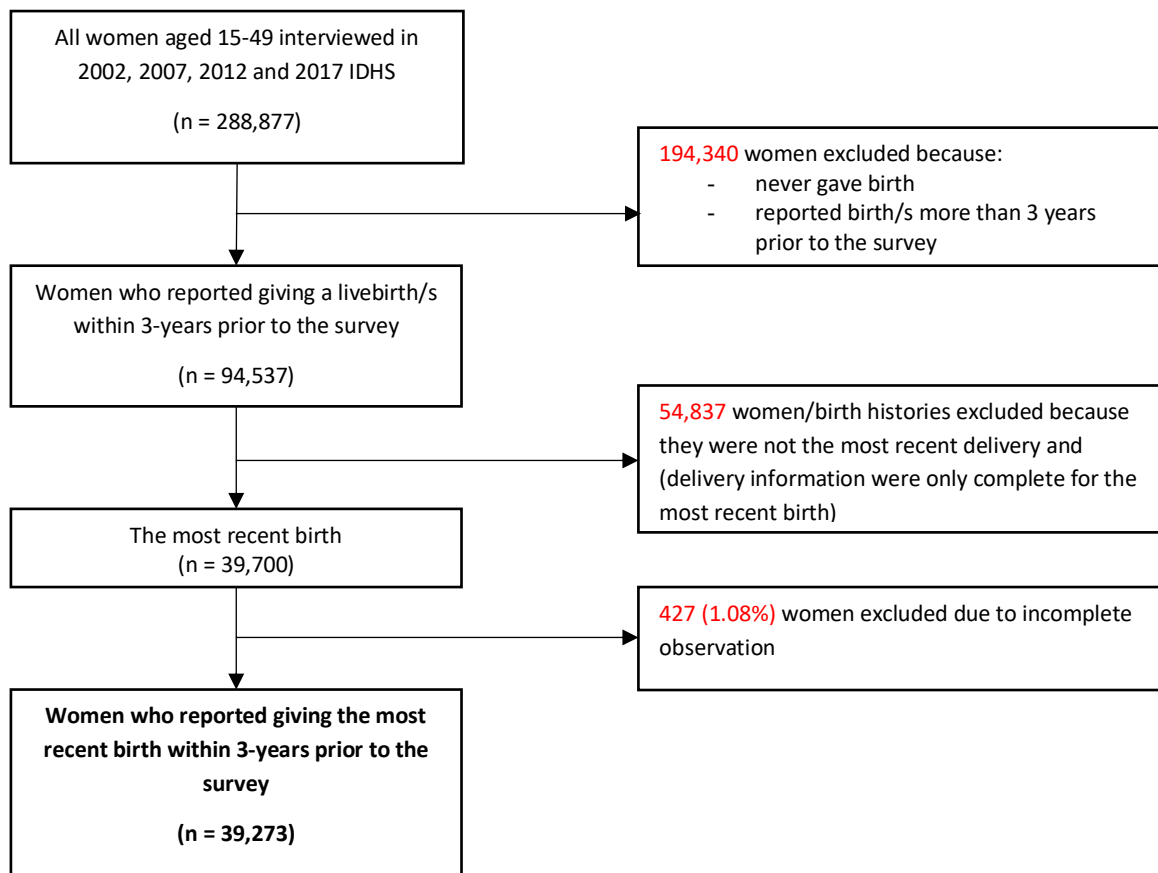
***p<0.01, **p<0.05, *p<0.1.

Appendix 2: Supplementary materials for Manuscript 2

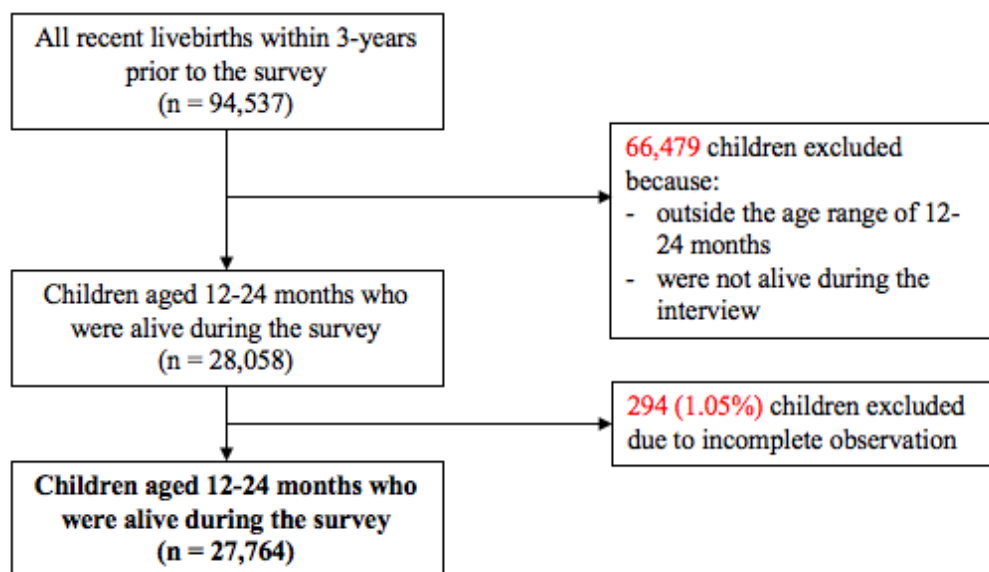
Manuscript 2 Appendix 1. Sample flowchart of 2002-2017 IDHS for Family Planning analyses



Manuscript 2 Appendix 2. Sample flowchart of 2002-2017 IDHS for ANC and maternal delivery analyses



Manuscript 2 Appendix 3. Sample flowchart of 2002-2017 IDHS for child immunisation analyses



Family Planning (FP) care cascade:

In order to construct the variables for FP services, we followed the definition for need and demand for family planning used by the DHS⁶ that is line with the United Nations Department of Economic and Social Affairs Population Division (UN-DESA) guideline.⁷

The **target population** for family planning was defined as married or non-married sexually active women aged 15-49 years old who were not pregnant at the time of the survey, intended to space or limit pregnancy for at two years and have not had sterilisation (including their male partner). Women who have been previously declared as infecund were also excluded from the target population for FP service. All currently married women were considered as being sexually active. And for women who were not reported as being married at the time of the survey, there is a need to determine whether they were currently sexually active. This information was assessed by asking the timing of the last sexual activity, with women who had sex in the last 4-weeks were categorised as sexually active. Women were categorised as not sexually active if they; (1) never had sex; (2) not active in the last 4-weeks due to postpartum period or; (3) not active in the last 4-weeks for any other reason. Spacing and limiting pregnancy was determined by assessing when and if the women wanted to have a (or another) child. The need for spacing applies for those women who wanted a (or another) child after 2+ years or of unsure timing as well as undecided. The need for limiting applies for women who expressed that they wanted no more children.

The variable for **service contact** for family planning was developed to assess whether a woman had the opportunity to be in contact with health care provider, which was captured by using the information on whether a woman has visited a health facility or was visited by a health worker in the last 6 months for any health reason. However, as the IDHS 2007, 2012 and 2017 had measured this information consistently, 2002 IDHS used the period of 12-months.

The variable for **crude coverage** for FP services was calculated based on the number of women who were the target population and had contact with health care provider (i.e. received *service contact*) and were currently using any modern family planning method. Those who had been sterilised or had a male partner who has been sterilised would be automatically excluded as they were not part of the *target population*. According to the World Health Organization⁸, the following methods constitute as modern FP methods and were included in IDHS: pill, IUD, injections, diaphragm, condom, sterilisation (which would have been excluded through the ‘target population’ variable), implant and lactational amenorrhea.

⁶ https://dhsprogram.com/data/Guide-to-DHS-Statistics/Need_and_Demand_for_Family_Planning.htm

⁷ <https://www.un.org/en/development/desa/population/publications/dataset/contraception/unmet.asp>

⁸ <https://www.who.int/news-room/fact-sheets/detail/family-planning-contraception>

The **quality-adjusted coverage** variable for FP service aims to capture that the target population was making an informed decision when using a modern contraceptive method. This was assessed by using FP Methods Information Index (MII)⁹, which is in line with previous definition by Amouzou et al¹⁰. The index summarises whether service providers have given adequate information to women when receiving the FP services in order to assist with making informed choice. Three questions were part of this index: (1) were you informed about other methods?; (2) were you informed about side effects?; (3) were you told what to do if you experienced side effect? Women who had made informed decision when choosing to use an FP method (or the ‘quality-adjusted coverage’) must confirmed that they have received all three information.

The **user-adherence-adjusted** coverage for FP is defined as women who use family planning method according to standards of use. In IDHS, the compliance to FP method guidelines could only be assessed for three types of modern FP method: (1) oral contraceptive pills; (2) injections and; (3) implant. This poses a limitation in assessing the compliance in using other methods (e.g. condoms). However, as the users of the three methods above make up for 79.7% of the total users of modern FP methods in Indonesia¹¹, this study would capture the compliance for the majority of the sample population.

For oral contraceptive pills, two types of commonly used contraceptive pills in Indonesia were included, i.e. combination (oestrogen and progesterone) and the progesterone-only pill (also called the ‘mini-pill’). According to Indonesia clinical guidelines on contraceptive use¹², both types of pills should be taken daily. Non-adherent in using the combination pills is if more than 48 hours (or 2 days) have passed since the last pill consumption. The non-adherent for progesterone-only pill is more than 24 hours (1 day). For injectables, two types were included, i.e. combined progestogen-oestrogen injections (monthly injections) and depo medroxyprogesterone acetate (DMPA) injections (3-monthly injections). However, in 2002 IDHS, the type of injection was not recorded and we assumed adherence using 3-monthly cut-off point. For implant, the current guideline prescribed that implants are to be replaced every 5-year, a cut-off point that we used to determine adherence for implant users. Questions from the IDHS and variables that contain information on the user-adherence is further explained in Appendix 5.

We could not calculate the outcome-adjusted coverage for family planning services due to data limitations.

Antenatal care (ANC) cascade:

⁹ https://www.measureevaluation.org/prh/rh_indicators/family-planning/method-choice/method-information-index#:~:text=Definition%3A,women%20to%20make%20informed%20choices.

¹⁰ Amouzou A, Leslie HH, Ram M, et al. Advances in the measurement of coverage for RMNCH and nutrition: from contact to effective coverage. *BMJ global health* 2019;4:e001297

¹¹ National Population and Family Planning Board (BKKBN), Ministry of Health, ICF, et al. Indonesia Demographic and Health Survey 2017. Jakarta, Indonesia: : BKKBN, BPS, Kemenkes, and ICF 2018. <https://dhsprogram.com/pubs/pdf/FR342/FR342.pdf>

¹² World Health Organization, Reproductive Health and Research, World Health Organization. *Selected practice recommendations for contraceptive use*. 2016. <http://www.ncbi.nlm.nih.gov/books/NBK409187/> (accessed 5 Sep 2020).

The **target population** for antenatal visit was defined as women aged 15-49 years old who reported a live birth(s) in the last 3 year prior to the survey. As the IDHS relies on respondents' recall, we limit our observation only to the most recent birth. And also, some information, e.g. the details of ANC services used, were only asked for the last birth.

ANC **service contact** variable captures the first contact that women had for the ANC service, i.e. whether they see any skilled health professional for any number of times for ANC services. Skilled health professionals were defined based on the Indonesia Ministry of Health guideline for ANC, which include general practitioners, obstetricians, nurse, midwife and village midwife. Other providers, e.g. traditional birth attendant, were categorised as a non-skilled and would exclude the women from having received a *service contact* for ANC service.

ANC **crude contact** was defined as women included in the target population that received at least 4 times ANC services. Ideally, the crude contact should also capture the timing of the ANC visits, as recommended by the WHO that ANC visit should occur at least once in both the first and second trimester and twice in the third trimester of the pregnancy¹³. However, our study could not take this into account, as this information was only assessed in the later waves of the IDHS and was not included in IDHS 2002 and 2007.

ANC **quality-adjusted coverage** variable captures the quality components of the services rendered, which was done by including the information on the key components of ANC service that should be provided by the health provider. From IDHS 2002, 2007, 2012 and 2017, the following ANC service components were assessed consistently; (1) weight measurement; (2) height measurement; (3) blood pressure measurement; (4) urine sample taken; (5) blood sample taken and; (6) pregnant women were given or bought iron tablets/syrups as supplementation during pregnancy. There are other components of ANC services that could be part of the *quality-adjusted coverage*, e.g. whether fundus examination and counselling on pregnancy signs and delivery preparation were given. However, these information were only assessed in IDHS 2012 and 2017 but not in the earlier versions.

ANC **user-adherence-adjusted coverage** variable aims to capture the women's compliance to clinical recommendation. As anaemia in pregnancy is prevalent in Indonesia, the Ministry of Health followed the WHO recommendation of daily iron supplementation for pregnant women for at least 90-days during pregnancy^{14,15}. And thus, *user-adherence coverage* was calculated using the information on whether the women consumed iron supplementation for at least 90 days of the pregnancy. Women who reported to have consumed non or less than 90-days of iron tablets or syrup were categorised as non-adherent.

We could not measure the outcome-adjusted coverage for ANC service, which would ideally be the outcome of the pregnancy, as this information was not available in the IDHS.

¹³ World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience. Geneva, Switzerland: : World Health Organization 2016. <https://www.who.int/publications-detail-redirect/9789241549912> (accessed 19 Aug 2020).

¹⁴ (https://www.who.int/elena/titles/full_recommendations/ifa_supplementation/en/)

¹⁵ (<http://kesga.kemkes.go.id/images/pedoman/PMK%20No.%2097%20tgg%20Pelayanan%20Kesehatan%20Kehamilan.pdf>)

Maternal delivery care cascade:

We used the same target population as ANC service, i.e. women aged 15-49 years who had recently given birth in the last 3-year prior to each survey wave and included only the most recent birth to anticipate for recall bias. The **service contact** was defined as having skilled birth attendance (SBA). The definition of skilled birth attendant was the same with those for ANC, which follows the WHO and the Indonesian Ministry of Health guideline that include these professions; general practitioners, obstetricians, nurse, midwife and village midwife. While the service contact used SBA as the definition, the delivery itself could occur at a health facility or any non-health facility (e.g. home delivery).

The **crude coverage** for maternal delivery was defined as having used skilled birth attendants and delivered in a health facility. The types of health facility included were; hospital, clinic, health post, maternity home, obstetrician clinic or midwife/nurse clinic.

We could not calculate the other coverage indicators for maternal delivery care due to inconsistencies in the Indonesia DHS questionnaires regarding the readiness assessment of the facility and types of interventions received (e.g. partograph recorded). And similar with ANC service, the outcome-adjusted coverage of delivery care would be the maternal and perinatal outcomes, information that is not available in the IDHS.

Child immunisation care cascade:

We defined the **target population** for immunisation service as children aged 1-2 years old who were alive during the interview. The **service contact** for child immunisation aims to capture the first contact that a child had with health care provider following the postnatal period but not immediately after. This would allow for a distinction between immediate postnatal services and when the child needed to come back to health service provider for their vaccination. Therefore, for *service contact*, we did not use vaccinations that would have been given immediately (or within 24-48 hours) after birth in the Indonesian context, e.g. BCG or Hepatitis B. Instead, we used the early vaccination that is scheduled at 2-months old, i.e. DPT-1. In IDHS, several measurements were used to assess a child's immunisation status, i.e. by asking the mother to recall the vaccination history, by checking the immunisation card (if available) and see whether the vaccination date was reported on the card or only marked as given in the card. In this study, we considered that all three measurements account constitutes as receiving the vaccination.

As the **crude coverage** variable captures the proportion of the target population who receive a needed health intervention after having a previous contact with health service, we used the coverage of DPT-1, DPT-2 and DPT-3 for the *crude coverage* for child immunisation. The other reason to use this was because our observation period spanned for over 16-years and DPT vaccination is one of a few vaccinations that has been consistently included in the national immunisation program and measured in IDHS.

The **quality-adjusted coverage** aims to capture how many of the target population that receive services according to clinical standards. While the scheduling and package of vaccination have evolved over the years, DPT1-3 and measles vaccinations remained relatively similar. And as according to Amouzou et al., quality-adjusted coverage for child

immunisation is defined as “*receives vaccination according to standards*”¹⁶, we included the coverage of DPT1-3 plus measles vaccination, which should be completed for children aged between 1-2 years old in Indonesia.

Finally, the **user-adherence-adjusted** coverage for child immunisation captures the proportion of the target population that not only received services according to recommended clinical standards, but also adhered to vaccination guidelines. This was captured by using the timing on when the children received their DPT1-3 and measles vaccination. In Indonesia, DPT-1, DPT-2 and DPT-3 are scheduled at 2, 4, 6 months old, respectively. Measles vaccination is recommended at 9-months.

Outcome-adjusted coverage for child immunisation could be seroconversion or the incidence or mortality due to vaccine-preventable diseases. However, as the IDHS did not collect this information, we could not calculate this variable.

¹⁶ Amouzou A, Leslie HH, Ram M, *et al.* Advances in the measurement of coverage for RMNCH and nutrition: from contact to effective coverage. *BMJ global health* 2019;**4**:e001297.

Family Planning service coverage

Variables	Source of measurement	Type	Measurement	Note
Target population: Married or sexually active non-married women who were not currently pregnant and intended to space or limit pregnancy and have not had sterilisation (including their male partner)	q226: Are you currently pregnant?	Binary	0. No or unsure 1. Yes	
	q1 (household schedule): What is (NAME)'s current marital status?	Categorical nominal	1. Never-married and never lived together 2. Married 3. Living together 4. Divorced 5. Separated 6. Widowed	Married women are assumed to be sexually active. For unmarried or previously married women, it was necessary to determine the timing of their recent sexual activity (in the following question below).
	q714: When was the last time you had sexual intercourse?	Categorical nominal	0. Never had intercourse 1. Active in the last 4 weeks 2. Not active in the last 4 weeks - postpartum 3. Not active in the last 4 weeks - not postpartum	Only applied to not currently married women.
	q804: Would you like to have (a/another) child, or would you prefer not to have any (more) children? q805: How long would you like b) to wait from now before the birth of (a/another) child?	Categorical nominal	1. Wants within 2 years 2. Wants after 2+ years 3. Wants, unsure timing 4. Undecided 5. Wants no more 6. Sterilized 7. Declared infecund 8. Never had sex	Women who are target population for FP service are those wanting to space or limit child birth, which include categories (2), (3), (4) and (5). Those who have gone sterilisation (including their male partner), declared infecund or never had sex are not included in the target population.
Service contact: Women who had contact with health service either by visiting a health facility or were visited by a health worker in the last 6-months (for any reason)	q327: In the last 6 (or 12) months, were you visited by a fieldworker?	Binary	0. No 1. Yes	In DHS 2002, the period was in the last 12 months, instead of 6 months.
	q329: In the last 6 (or 12) months, have you visited a health facility?	Binary	0. No 1. Yes	
Crude coverage: Women who were the target population of FP service and had contact with health service provider and were using any modern family planning method.	q307a: Are you currently using any contraceptive method? Q306b: Which method are you using?	Categorical nominal	0. Not using 1. Pill 2. IUD 3. Injections 3 month 5. Male condom 6. Female sterilisation 7. Male sterilisation 8. Periodic abstinence 9. Withdrawal 10. Other traditional 11. Implants/norplant 13. Lactational amenorrhea 17. Other modern method 19. Injection 1 month	Modern methods include: pill, IUD, injections, diaphragm, condom, sterilisation (which would have been excluded through the 'target population' variable), Norplant (implant) and lactational amenorrhea. Type of injections (1-month or 3-months) was only asked in DHS 2017.
Quality-adjusted coverage: Women who were the target population of FP service, had contact with health service provider, currently using any modern FP method and scored for all of the FP Methods Information Index	q322: were you told about other methods of family planning that you could use? q323: Were you ever told by a health or family planning worker about other methods of family planning that you could use?	Binary	0. No 1. Yes	The methods information index is an indicator summarising whether service providers give adequate information to women when receiving FP services in order to
	q318: At that time, were you told about	Binary	0. No 1. Yes	

	side effects or problems you might have with the method? q320: Were you ever told by a health or family planning worker about side effects or problems you might have with the method?			assist with making informed choices. ¹⁷ The index consists of three questions: 1. Were you informed about other methods? 2. Were you informed about side effects? 3. Were you told what to do if you experienced side effects?
	q321: Were you told what to do if you experienced side effects or problems?	Binary	0. No 1. Yes	
User-adherence-adjusted coverage: Women who were the target population for FP service, had contact with health service provider, currently using a modern FP method after receiving pertinent information on FP methods and adhered to the standards of FP method use.	q305a: Please show me the package of pills you are now using.	Binary	0. No 1. Yes	User-adherence can only be calculated for those using either pill, injectables or implant. According to 2017 DHS, the users of these three methods make up 79.7% of total users of modern FP methods. ¹⁸
	q305a: Record type of pills	Categorical nominal	1. Combination 2. Single 3. Other 4. Not seen	
	q305c: CHECK THE PACKET FOR PILL USE AND CIRCLE THE CORRECT CODE.	Categorical nominal	1. Pills missing in order 2. Pills missing out of order 3. No pills missing	
	q305e: When was the last time you took a pill?	Numerical	Range: 0-30 days	
	q306: How many weeks ago did you have an injection?	Numerical	Range: 1-36 weeks	
	q306d: When did you start using implant? (Compute duration of implant use)	Numerical	Range: 0-90 months	

¹⁷ https://www.measureevaluation.org/prh/rh_indicators/family-planning/method-choice/method-information-index

¹⁸ National Population and Family Planning Board (BKKBN), Ministry of Health, ICF, et al. Indonesia Demographic and Health Survey 2017. Jakarta, Indonesia: : BKKBN, BPS, Kemenkes, and ICF 2018. <https://dhsprogram.com/pubs/pdf/FR342/FR342.pdf>

Antenatal care service coverage

Variables	Source of measurement	Type	Measurement	Note
Target population: Women who had recently given a livebirth/s within the last 3-years of each survey wave	q402: Number of births in the last five years	Continuous	Range 0-3 children	
Service contact: Women with a recent live birth within 3-years prior to each survey wave and received any number of ANC service	q408: Did you see anyone for antenatal care for this pregnancy?	Binary	0. No 1. Yes	Skilled health professionals for ANC service include: general practitioner, obstetrician, nurse, midwife and village midwife.
	q409: Whom did you see?	Categorical nominal	1) General practitioner 2) Obstetrician 3) Nurse 4) Midwife 5) Village midwife 6) Traditional birth attendant 7) Other	
Crude coverage: Women with a recent live birth within 3-years prior to each survey wave and received at least 4 times ANC services	q412: How many times did you receive antenatal care during this pregnancy?	Continuous	Range 0-36	
Quality-adjusted coverage: Women with a recent live birth within 3-years prior to each survey wave and received at least 4 times ANC services and key components of ANC from a health provider, which include: weight and height measured, blood pressure, urine sample and blood sample taken, given/bought iron tablets/syrup	q413: As part of your antenatal care during this pregnancy, were any of the following done at least once? A) Was your weight measured? B) Was your height measured? C) Was your blood pressure measured? H) Did you give a blood sample? i) Did you give a urine sample? q420: During this pregnancy, were you given or did you buy any iron tablets or iron syrup?	Binary	0. No 1. Yes	
User-adherence-adjusted coverage: Women with a recent live birth within 3-years prior to each survey wave and received at least 4 times ANC services and key components of ANC from a health provider, which include: weight and height measured, blood pressure, urine sample and blood sample taken, given/bought iron tablets/syrup and adhered to consuming iron supplementation for at least 90 days during the pregnancy	q421: During the whole pregnancy, for how many days did you take the tables or syrup?	Continuous	Range 0-300	

Maternal delivery service coverage

Variables	Source of measurement	Type	Measurement	Note
Target population: Women who had recently given a livebirth/s within the last 3-years of each survey wave	q402: Number of births in the last five years	Continuous	Range 0-3 children	
Service contact: Delivery attended by a skilled health provider	q429: Who assisted with the delivery of (child's name)?	Categorical nominal	a) General practitioner b) Obstetrician c) Nurse d) Midwife e) Village midwife f) Traditional birth attendant g) Relative/friend x) Other y) No one assisted	Skilled birth attendant includes general practitioner, obstetrician, nurse, midwife and village midwife
Crude coverage: Skilled birth attendance at a health facility	q430: Where did you give birth to (child's name)?	Categorical nominal	11) Respondent's home 12) Other home 21) Village maternity post 22) Integrated health service post 23) Other community-based health care 31) Public hospital 32) Public clinic 33) Public primary health centre 34) Public sub/mobile primary health care 35) Public village midwife 41) Private hospital/maternity hospital 42) Private maternity clinic 43) Private OBGYN 44) Private general practitioner clinic 45) Private midwife clinic 46) Private nurse clinic 47) Other	Type of health facility: - Hospital - Clinic - Health post - Maternity home - OB-GYN clinic - Midwife/nurse clinic

Child immunisation

Variables	Source of measurement	Type	Measurement	Note
Target population: All children aged 12-24 women who were alive during the survey				
Service contact: Children aged 12-24 women who were alive during the survey who received DPT-1 vaccination	q517b: Has (NAME) ever received a DPT vaccination, that is, an injection to prevent diphtheria, pertussis and tetanus, given in the thigh sometimes at the same time as polio drops?	Categorical nominal	0) No 1) Vaccination date on card 2) Reported by mother 3) Vaccination marked on card 4) Don't know	A child is considered to have received DPT immunisation if either: (1) the vaccination date was reported on the immunisation card, (2) the mother reported that the vaccination was given or (3) the vaccination was marked on the immunisation card
Crude coverage: Children aged 12-24 women who were alive during the survey who received DPT-1, DPT-2 and DPT-3 vaccination	q517aa: How many times did (NAME) receive the DPT vaccine?	Continuous	Range 0-3	
Quality-adjusted coverage: Children aged 12-24 women who were alive during the survey who received DPT-1, DPT-2, DPT-3 and measles vaccination	q523a: Has (NAME) ever received a measles vaccination, that is, an injection in the arm to prevent measles?	Categorical nominal	0) No 1) Vaccination date on card 2) Reported by mother 3) Vaccination marked on card 4) Don't know	
User-adherence-adjusted coverage: Children aged 12-24 women who were alive during the survey who received DPT-1, DPT-2, DPT-3 and measles vaccination according to the national Indonesia immunisation schedule	q508a: Copy dates from immunisation card	Continuous	Date format	According to Indonesia child immunisation guideline, schedule for: 1) DPT-1: at 2-months 2) DPT-2: at 4-months 3) DPT-3: at 6-months 4) Measles: at 9-months

*Manuscript 2 Appendix 6. Socioeconomic characteristics (% [95% CI]), based on survey wave**

Family Planning Target Population					ANC and Delivery Service Target Population				Child Immunisation Target Population			
Variable	IDHS 2002	IDHS 2007	IDHS 2012	IDHS 2017	IDHS 2002	IDHS 2007	IDHS 2012	IDHS 2017	IDHS 2002	IDHS 2007	IDHS 2012	IDHS 2017
Wealth quintile												
Poorest	20.54 (18.41, 22.84)	17.70 (16.20, 19.32)	17.63 (16.29, 19.05)	16.89 (15.73, 18.12)	22.44 (20.10, 24.98)	22.03 (20.19, 24.00)	20.88 (19.23, 22.63)	20.06 (18.66, 21.53)	21.97 (19.50, 24.67)	21.33 (19.42, 23.37)	20.59 (18.82, 22.48)	19.97 (18.45, 21.58)
Poor	19.64 (18.14, 21.23)	19.79 (18.36, 21.29)	19.49 (18.3, 20.71)	20.19 (19.29, 21.12)	19.12 (17.33, 21.06)	19.32 (17.84, 20.89)	19.92 (18.50, 21.42)	20.99 (19.81, 22.22)	18.63 (16.70, 20.73)	18.52 (16.88, 20.28)	21.21 (19.54, 22.98)	20.23 (18.87, 21.67)
Middle	19.59 (18.16, 21.12)	20.54 (19.30, 21.84)	20.14 (19.12, 21.19)	21.00 (20.11, 21.93)	19.95 (18.26, 21.76)	20.53 (19.07, 22.07)	19.90 (18.60, 21.26)	19.86 (18.77, 20.99)	19.77 (17.80, 21.90)	20.68 (18.95, 22.51)	19.58 (18.10, 21.15)	19.77 (18.47, 21.15)
Rich	19.84 (18.32, 21.45)	21.04 (19.64, 22.50)	22.00 (20.79, 23.27)	21.39 (20.50, 22.32)	19.82 (17.97, 21.81)	18.93 (17.49, 20.46)	20.92 (19.47, 22.45)	20.35 (19.21, 21.53)	20.16 (18.25, 22.21)	20.18 (18.45, 22.03)	20.04 (18.49, 21.70)	20.98 (19.66, 22.37)
Richest	20.39 (18.46, 22.47)	20.93 (19.10, 22.89)	20.74 (19.15, 22.43)	20.52 (19.25, 21.86)	18.66 (16.64, 20.86)	19.19 (17.23, 21.31)	18.38 (16.77, 20.12)	18.75 (17.37, 20.21)	19.47 (17.13, 22.04)	19.30 (17.16, 21.63)	18.58 (16.82, 20.48)	19.04 (17.52, 20.66)
Women's age												
15-25 years	19.76 (18.70, 20.87)	18.09 (17.18, 19.05)	15.68 (14.84, 16.57)	12.50 (11.89, 13.14)	36.82 (35.16, 38.52)	35.08 (33.48, 36.72)	32.28 (30.82, 33.78)	27.29 (26.15, 28.46)	39.91 (37.92, 41.94)	37.86 (35.98, 39.78)	34.62 (32.90, 36.39)	29.35 (27.93, 30.80)
26-35 years	39.89 (38.62, 41.17)	38.86 (37.72, 40.02)	37.66 (36.60, 38.73)	35.04 (34.23, 35.87)	47.62 (45.78, 49.46)	47.90 (46.29, 49.51)	49.87 (48.33, 51.40)	51.69 (50.45, 52.93)	45.91 (43.79, 48.05)	47.26 (45.35, 49.18)	49.46 (47.65, 51.27)	51.65 (50.14, 53.15)
36-42 years	25.12 (24.10, 26.17)	24.83 (23.87, 25.81)	27.23 (26.26, 28.22)	28.74 (27.95, 29.54)	13.81 (12.64, 15.07)	14.66 (13.61, 15.78)	15.62 (14.56, 16.74)	18.37 (17.43, 19.34)	12.86 (11.47, 14.39)	13.35 (12.15, 14.64)	14.46 (13.25, 15.75)	16.91 (15.83, 18.04)
42-49 years	15.23 (14.29, 16.22)	18.22 (17.31, 19.16)	19.43 (18.58, 20.31)	23.71 (22.94, 24.50)	1.75 (1.28, 2.40)	2.36 (1.94, 2.86)	2.23 (01.84, 2.71)	2.66 (2.27, 3.10)	1.31 (0.90, 1.91)	1.53 (1.16, 2.00)	1.46 (1.09, 1.95)	2.10 (1.68, 2.62)
Women's marital status												
Not married	0 (0.00, 0.00)	0 (0.00, 0.00)	0.55 (0.43, 0.71)	0.57 (0.45, 0.71)	1.55 (1.21, 1.99)	2.12 (1.73, 2.59)	3.02 (2.60, 3.50)	3.25 (2.87, 3.67)	1.35 (0.98, 1.86)	1.59 (1.21, 2.09)	2.93 (2.41, 3.55)	2.93 (2.51, 3.41)
Married	100 (100.00, 100.00)	100 (100.00, 100.00)	99.45 (99.29, 99.57)	99.43 (99.29, 99.55)	98.45 (98.01, 98.79)	97.88 (97.41, 98.27)	96.98 (96.50, 97.40)	96.75 (96.33, 97.13)	98.65 (98.14, 99.02)	98.41 (97.91, 98.79)	97.07 (96.45, 97.59)	97.07 (96.59, 97.49)
Parity												
1 child	23.26 (21.98, 24.59)	24.36 (23.21, 25.55)	25.19 (24.07, 26.34)	22.13 (21.33, 22.95)	38.25 (36.27, 40.28)	36.22 (34.59, 37.88)	29.49 (28.07, 30.96)	31.89 (30.70, 33.10)	37.72 (35.40, 40.10)	35.66 (33.75, 37.61)	29.10 (27.48, 30.79)	32.32 (30.89, 33.78)
2 or more children	76.74 (75.41, 78.02)	75.64 (74.45, 76.79)	74.81 (73.66, 75.93)	77.87 (77.05, 78.67)	61.75 (59.72, 63.73)	63.78 (62.12, 65.41)	70.51 (69.04, 71.93)	68.11 (66.90, 69.30)	62.28 (59.90, 64.60)	64.34 (62.39, 66.25)	70.90 (69.21, 72.52)	67.68 (66.22, 69.11)
Women's education												
None	6.88 (5.93, 7.97)	5.21 (4.48, 6.04)	3.20 (2.73, 3.74)	1.31 (1.09, 1.59)	4.62 (3.70, 5.76)	3.09 (2.49, 3.83)	1.95 (1.55, 2.45)	1.03 (0.77, 1.38)	3.95 (3.07, 5.07)	2.33 (1.82, 2.97)	1.97 (1.52, 2.56)	0.89 (0.65, 1.24)
Primary	54.10 (52.12, 56.06)	47.25 (45.45, 49.06)	39.64 (37.89, 41.42)	35.00 (33.61, 36.41)	46.85 (44.42, 49.30)	40.24 (38.21, 42.28)	30.88 (29.10, 32.72)	24.41 (22.98, 25.90)	45.41 (42.78, 48.07)	38.47 (36.26, 40.74)	29.47 (27.58, 31.43)	23.24 (21.71, 24.84)
Secondary	34.13 (32.33, 35.98)	40.73 (39.15, 42.33)	47.70 (46.14, 49.27)	52.98 (51.69, 54.26)	42.25 (40.01, 44.35)	4.84 (46.54, 50.27)	54.70 (52.90, 56.48)	58.31 (56.78, 59.84)	44.15 (41.71, 46.62)	50.4 (48.25, 52.56)	55.25 (53.29, 57.19)	59.07 (57.33, 60.78)
Post-secondary	4.89 (4.19, 5.69)	6.81 (6.09, 7.61)	(8.48, 10.54)	10.71 (10.00, 11.47)	6.27 (5.44, 7.22)	8.28 (7.29, 9.39)	12.48 (11.08, 14.02)	16.25 (15.15, 17.41)	6.49 (5.49, 7.65)	8.80 (7.64, 10.10)	13.31 (11.71, 15.09)	16.80 (15.55, 18.12)
Women's occupation												
None	55.96 (52.72, 58.17)	48.89 (47.22, 50.56)	56.38 (54.88, 57.86)	39.66 (38.57, 40.77)	63.37 (61.14, 65.55)	54.85 (53.05, 56.64)	51.86 (50.13, 53.58)	5.33 (5.19, 5.47)	66.32 (63.94, 68.62)	58.31 (56.19, 60.40)	55.16 (53.26, 57.06)	56.42 (54.78, 58.04)
Agriculture	23.58 (21.39, 25.92)	22.68 (20.88, 24.60)	14.23 (12.98, 15.59)	14.76 (13.71, 15.88)	15.57 (13.85, 17.45)	15.73 (14.14, 17.46)	9.77 (8.68, 10.99)	7.70 (6.86, 8.65)	13.7 (11.95, 15.66)	12.95 (11.38, 14.70)	8.78 (7.67, 10.03)	6.72 (5.87, 7.68)
Blue-collar	3.04 (2.55, 3.63)	6.41 (5.72, 7.17)	4.61 (4.13, 5.14)	17.15 (16.24, 18.09)	16.32 (14.79, 17.96)	23.75 (22.12, 25.46)	2.82 (26.73, 29.73)	27.55 (26.33, 28.80)	15.05 (13.43, 16.83)	22.71 (20.89, 24.64)	25.38 (23.81, 27.02)	25.11 (23.75, 26.53)
White-collar	17.42 (16.18, 18.72)	22.02 (20.82, 23.26)	24.78 (23.64, 25.96)	28.42 (27.49, 29.38)	4.75 (4.02, 5.61)	5.67 (4.96, 6.47)	10.17 (9.18, 11.25)	11.44 (10.63, 12.31)	4.93 (3.98, 6.10)	6.03 (5.15, 7.06)	10.68 (9.48, 12.00)	11.75 (10.80, 12.77)
Residency												
Rural	53.77 (49.57, 57.92)	57.56 (54.04, 61.00)	50.03 (46.95, 53.10)	51.68 (49.41, 53.95)	52.67 (48.64, 56.67)	58.59 (55.22, 61.88)	50.74 (47.61, 53.87)	51.47 (49.18, 53.75)	52.63 (48.33, 56.89)	58.01 (54.51, 61.43)	51.04 (47.77, 54.29)	51.36 (48.91, 53.80)
Urban	46.23 (42.08, 50.43)	42.44 (39.00, 45.96)	49.97 (46.90, 53.05)	48.32 (46.05, 50.59)	47.33 (43.33, 51.36)	41.41 (38.12, 44.78)	49.26 (46.13, 52.39)	48.53 (46.25, 50.82)	47.37 (43.11, 51.67)	41.99 (38.57, 45.49)	48.96 (45.71, 52.23)	48.64 (46.20, 51.09)
Region of residency												
Java-Bali	62.90 (59.24, 66.41)	62.98 (60.07, 65.79)	61.10 (58.45, 63.68)	61.67 (59.55, 63.75)	57.07 (53.25, 60.81)	55.29 (52.14, 58.40)	55.82 (52.90, 58.70)	55.74 (53.51, 57.95)	56.23 (52.15, 60.23)	54.79 (51.50, 58.05)	55.33 (52.27, 58.35)	55.67 (53.28, 58.03)
Sumatera	20.80 (18.13, 23.75)	18.58 (16.69, 20.63)	20.80 (18.97, 22.76)	20.72 (19.03, 22.52)	22.61 (19.86, 25.62)	21.78 (19.64, 24.08)	22.59 (20.61, 24.69)	22.96 (21.13, 24.80)	23.33 (20.36, 26.59)	22.64 (20.29, 25.18)	22.57 (20.53, 24.76)	23.04 (21.10, 25.10)
Kalimantan	5.88 (4.96, 6.96)	6.21 (5.22, 7.22)	6.22 (5.44, 7.10)	6.25 (5.34, 7.30)	6.91 (5.82, 8.19)	6.55 (5.56, 7.72)	6.37 (5.49, 7.38)	6.26 (5.31, 7.37)	6.58 (5.73, 8.18)	6.32 (5.31, 7.49)	6.43 (5.52, 7.47)	5.88 (4.94, 6.99)
Sulawesi	7.34 (5.71, 9.39)	7.16 (6.21, 8.23)	6.69 (5.89, 7.50)	6.19 (5.45, 7.03)	8.79 (6.59, 11.63)	8.39 (7.29, 9.63)	7.40 (6.50, 8.41)	7.12 (6.29, 8.05)	8.85 (6.64, 11.70)	8.36 (7.25, 9.64)	7.84 (6.83, 8.98)	7.34 (6.44, 8.35)
Eastern Indonesia	3.07 (2.43, 3.89)	5.08 (4.33, 5.95)	5.19 (4.51, 5.98)	5.17 (4.54, 5.88)	4.61 (3.61, 5.88)	7.99 (6.81, 9.37)	7.82 (6.77, 9.02)	7.92 (7.11, 8.80)	4.73 (3.64, 6.13)	7.89 (6.71, 9.25)	7.83 (6.74, 9.08)	8.07 (7.19, 9.05)

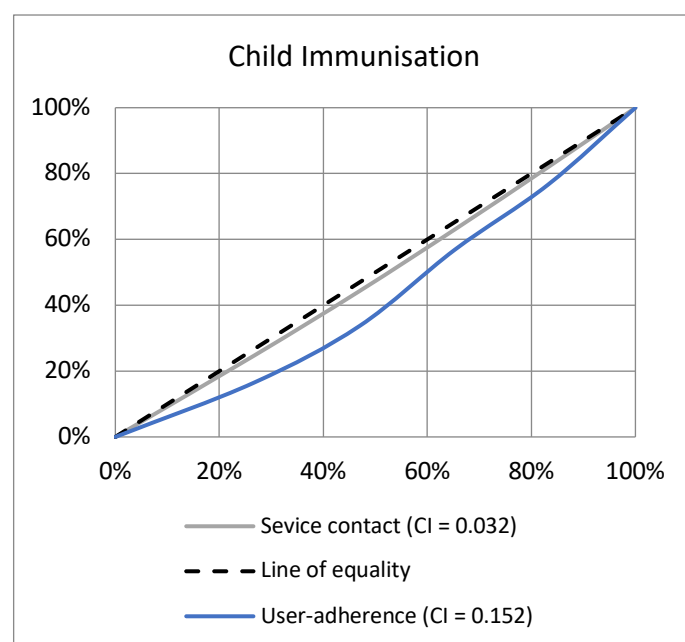
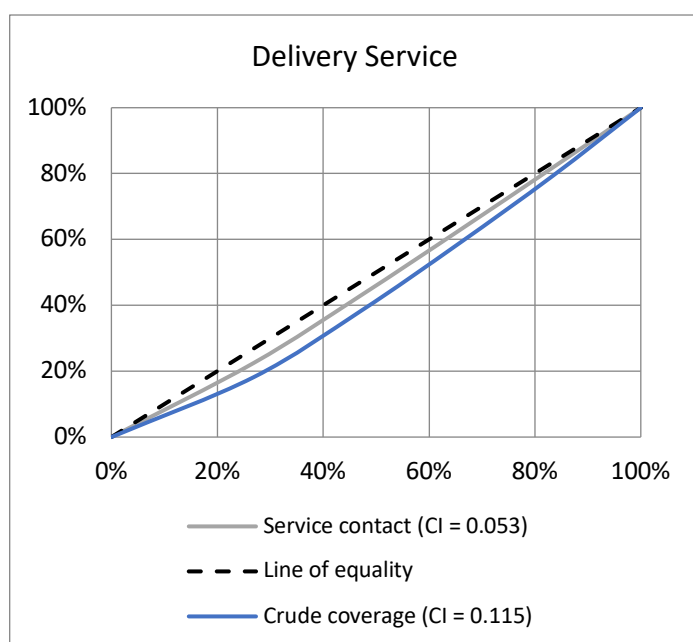
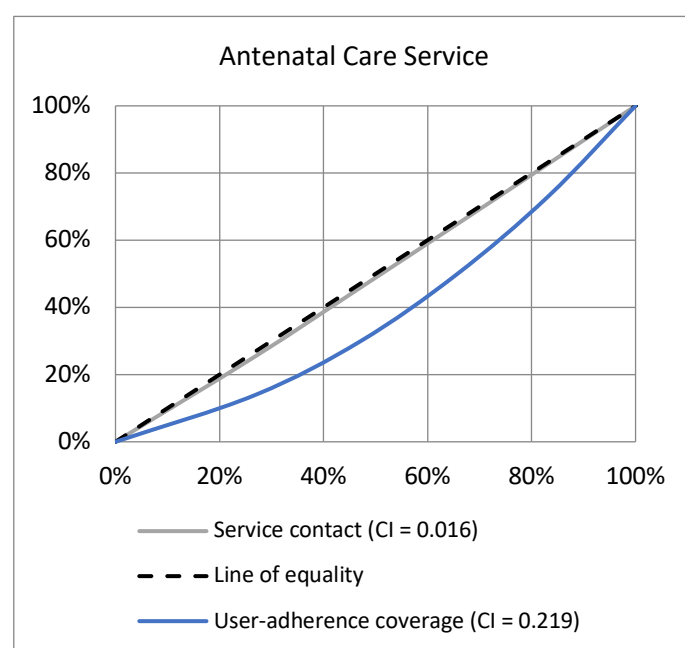
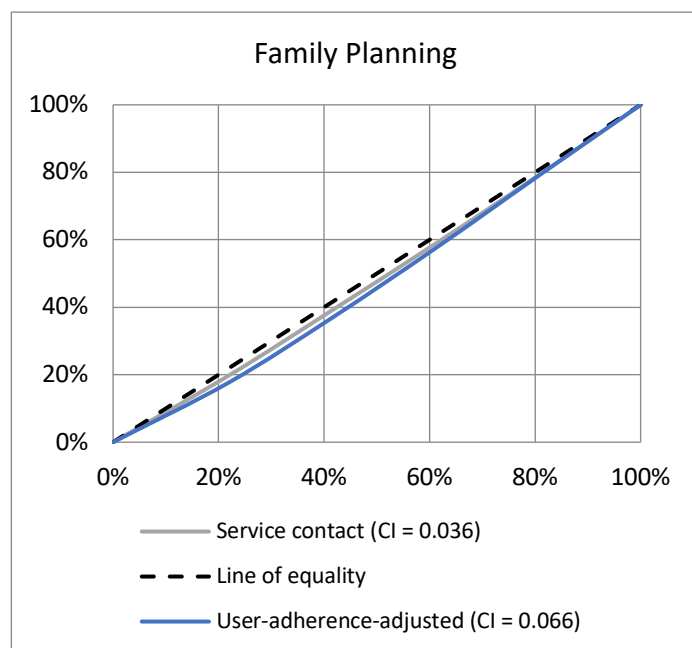
* Weighted proportions

Manuscript 2 Appendix 7. Trends in the concentration indices of coverage of RMCH interventions, 2002-2017

RMCH Service	2002	2007	2012	2017
	Concentration index (95% CI)	Concentration index (95% CI)	Concentration index (95% CI)	Concentration index (95% CI)
Family planning services				
Service contact	0.064 (0.054 to 0.074)	0.048 (0.039 to 0.058)	0.038 (0.031 to 0.046)	0.033 (0.026 to 0.040)
Crude coverage	0.075 (0.063 to 0.088)	0.058 (0.046 to 0.069)	0.023 (0.013 to 0.032)	0.004 (-0.00 to 0.013)
Quality-adjusted coverage	0.110 (0.083 to 0.137)	0.150 (0.124 to 0.177)	0.112 (0.087 to 0.138)	0.053 (0.029 to 0.077)
User-adherence-adjusted coverage	0.112 (0.083 to 0.140)	0.161 (0.133 to 0.189)	0.116 (0.089 to 0.142)	0.056 (0.032 to 0.081)
Antenatal care service				
Service contact	0.023 (0.021 to 0.026)	0.029 (0.026 to 0.032)	0.025 (0.022 to 0.028)	0.015 (0.013 to 0.017)
Crude coverage	0.088 (0.082 to 0.094)	0.102 (0.096 to 0.108)	0.073 (0.068 to 0.079)	0.044 (0.039 to 0.048)
Quality-adjusted coverage	0.363 (0.335 to 0.391)	0.272 (0.243 to 0.302)	0.154 (0.127 to 0.181)	0.162 (0.142 to 0.181)
User-adherence-adjusted coverage	0.433 (0.396 to 0.469)	0.337 (0.297 to 0.377)	0.207 (0.169 to 0.246)	0.219 (0.193 to 0.245)
Delivery care				
Service contact	0.168 (0.160 to 0.176)	0.154 (0.147 to 0.161)	0.107 (0.101 to 0.112)	0.053 (0.049 to 0.057)
Crude coverage	0.374 (0.361 to 0.386)	0.334 (0.323 to 0.345)	0.215 (0.206 to 0.224)	0.114 (0.108 to 0.120)
Child immunisation				
Service contact	0.073 (0.064 to 0.082)	0.084 (0.075 to 0.093)	0.058 (0.051 to 0.066)	0.032 (0.025 to 0.039)
Crude coverage	0.120 (0.104 to 0.136)	0.135 (0.121 to 0.148)	0.098 (0.087 to 0.109)	0.059 (0.048 to 0.070)
Quality-adjusted coverage	0.112 (0.094 to 0.131)	0.126 (0.109 to 0.143)	0.097 (0.082 to 0.112)	0.044 (0.029 to 0.059)
User-adherence-adjusted coverage	0.239 (0.169 to 0.309)	0.159 (0.086 to 0.232)	0.221 (0.171 to 0.271)	0.152 (0.104 to 0.199)

* Weighted for survey design

Manuscript 2 Appendix 8. Concentration curve for effective coverage of RMCH service coverage, 2017



Manuscript 2 Appendix 9. Coverage of family planning service by wealth quintile and concentration indices, 2002-2007

RMCH Indicators	IDHS 2002	IDHS 2007	IDHS 2012	IDHS 2017
Service contact				
Wealth quintile				
Poorest	31.37 (28.31, 34.60)	34.85 (32.15, 37.65)	48.81 (46.20, 51.42)	50.69 (48.52, 52.86)
Poor	37.66 (34.88, 40.53)	41.44 (38.42, 44.53)	53.81 (51.31, 56.30)	55.19 (53.14, 57.23)
Middle	40.36 (37.22, 43.59)	44.59 (41.80, 47.42)	55.44 (52.92, 57.92)	56.27 (54.20, 58.32)
Rich	39.87 (36.53, 43.30)	47.37 (44.67, 50.08)	57.34 (54.79, 59.85)	58.06 (56.12, 59.96)
Richest	39.30 (36.36, 42.32)	50.00 (47.37, 52.62)	59.24 (56.55, 61.88)	60.49 (58.55, 62.40)
Concentration index	0.064 (0.054 to 0.074)	0.048 (0.039 to 0.058)	0.038 (0.031 to 0.046)	0.033 (0.026 to 0.040)
Crude coverage				
Wealth quintile				
Poorest	31.83 (29.57, 34.17)	37.33 (35.26, 39.45)	47.49 (45.60, 49.38)	44.66 (43.33, 46.00)
Poor	27.20 (25.08, 29.43)	31.01 (28.89, 33.21)	38.31 (36.59, 40.06)	41.47 (39.71, 43.25)
Middle	28.00 (25.31, 30.87)	40.86 (37.45, 44.36)	43.05 (40.92, 45.20)	43.31 (40.68, 45.98)
Rich	24.34 (21.75, 27.12)	29.98 (27.18, 32.95)	38.39 (36.07, 40.76)	40.81 (38.20, 43.47)
Richest	37.88 (32.43, 43.64)	28.17 (24.81, 31.79)	35.94 (33.31, 38.65)	34.32 (31.63, 37.13)
Concentration index	0.075 (0.063 to 0.088)	0.058 (0.046 to 0.069)	0.023 (0.013 to 0.032)	0.004 (-0.00 to 0.013)
Quality-adjusted				
Wealth quintile				
Poorest	5.80 (5.00, 6.72)	8.87 (7.87, 9.99)	11.09 (10.01, 12.28)	10.59 (9.84, 11.39)
Poor	8.43 (7.26, 9.77)	6.34 (5.48, 7.33)	6.5 (5.84, 7.35)	8.82 (7.87, 9.87)
Middle	9.56 (8.00, 11.39)	9.73 (8.08, 11.67)	7.70 (6.47, 9.13)	10.64 (9.20, 12.28)
Rich	6.45 (4.80, 8.61)	6.48 (5.42, 7.73)	6.03 (5.08, 7.14)	7.97 (6.81, 9.30)
Richest	11.54 (9.26, 14.29)	8.99 (7.28, 11.06)	9.72 (8.03, 11.73)	10.16 (8.70, 11.82)
Concentration index	0.110 (0.083 to 0.137)	0.150 (0.124 to 0.177)	0.112 (0.087 to 0.138)	0.053 (0.029 to 0.077)
User-adherence-adjusted				
Wealth quintile				
Poorest	5.19 (4.46, 6.03)	8.31 (7.33, 9.40)	10.83 (9.78, 11.98)	10.31 (9.57, 11.10)
Poor	7.71 (6.54, 6.33)	5.43 (4.66, 6.33)	6.20 (5.50, 6.98)	8.28 (7.37, 9.30)
Middle	8.80 (7.16, 10.77)	8.80 (7.16, 10.77)	7.49 (6.28, 8.90)	10.21 (8.78, 11.84)
Rich	5.70 (4.70, 6.90)	5.70 (4.70, 6.90)	5.73 (4.83, 6.80)	7.32 (6.22, 8.61)
Richest	7.82 (6.25, 9.74)	7.82 (6.25, 9.74)	9.35 (7.68, 11.33)	9.66 (8.24, 11.30)
Concentration index	0.112 (0.083 to 0.140)	0.161 (0.133 to 0.189)	0.116 (0.089 to 0.142)	0.056 (0.032 to 0.081)

Manuscript 2 Appendix 10. Trends in wealth-based equality in antenatal care service, 2002-2007

RMCH Indicators	IDHS 2002	IDHS 2007	IDHS 2012	IDHS 2017
Service contact				
Wealth quintile				
Poorest	89.57 (87.06, 91.64)	88.07 (86.01, 89.86)	90.00 (87.95, 91.73)	91.74 (89.51, 93.53)
Poor	94.79 (92.41, 96.45)	95.62 (93.98, 96.83)	97.37 (96.34, 98.11)	97.66 (96.68, 98.35)
Middle	95.75 (93.36, 97.30)	97.41 (96.00, 98.34)	98.31 (97.26, 98.96)	98.68 (98.04, 99.11)
Rich	99.09 (97.51, 99.67)	99.40 (98.79, 99.71)	99.70 (99.43, 99.85)	98.92 (98.18, 99.36)
Richest	99.85 (99.44, 99.96)	99.35 (98.01, 99.79)	99.74 (99.42, 99.88)	99.48 (99.01, 99.73)
Concentration index	0.023 (0.021 to 0.026)	0.029 (0.026 to 0.032)	0.025 (0.022 to 0.028)	0.015 (0.013 to 0.017)
Crude coverage				
Wealth quintile				
Poorest	63.89 (59.93, 67.67)	60.10 (56.90, 63.21)	69.71 (67.01, 72.28)	78.44 (75.48, 81.14)
Poor	77.46 (73.58, 80.91)	79.53 (76.21, 82.50)	86.89 (84.65, 88.84)	88.94 (87.19, 90.48)
Middle	81.95 (76.62, 86.28)	83.91 (80.75, 86.64)	91.85 (90.08, 93.33)	92.93 (91.25, 94.31)
Rich	89.30 (86.36, 91.67)	91.35 (89.16, 93.13)	95.36 (93.77, 96.55)	95.22 (93.94, 96.25)
Richest	95.72 (90.93, 98.04)	96.43 (94.53, 97.69)	97.17 (95.99, 98.01)	97.15 (96.16, 97.89)
Concentration index	0.088 (0.082 to 0.094)	0.102 (0.096 to 0.108)	0.073 (0.068 to 0.079)	0.044 (0.039 to 0.048)
Quality-adjusted				
Wealth quintile				
Poorest	3.03 (2.24, 4.08)	4.11 (3.09, 5.43)	9.51 (7.98, 11.30)	15.02 (13.02, 17.27)
Poor	7.16 (4.98, 4.08)	6.04 (4.65, 7.82)	14.21 (12.05, 16.68)	20.93 (18.51, 23.58)
Middle	7.98 (6.04, 10.48)	8.94 (7.06, 11.24)	13.46 (11.24, 16.03)	27.35 (24.69, 30.19)
Rich	12.59 (10.05, 15.56)	12.06 (10.06, 14.40)	18.22 (15.44, 21.39)	31.76 (28.91, 34.76)
Richest	20.43 (17.16, 24.15)	15.27 (12.58, 18.42)	20.40 (17.49, 23.66)	33.44 (30.32, 36.72)
Concentration index	0.363 (0.335 to 0.391)	0.272 (0.243 to 0.302)	0.154 (0.127 to 0.181)	0.162 (0.142 to 0.181)
User-adherence-adjusted				
Wealth quintile				
Poorest	1.10 (0.69, 1.75)	1.80 (1.16, 2.77)	5.37 (4.13, 6.95)	8.52 (7.02, 10.31)
Poor	3.01 (1.90, 4.74)	2.79 (1.87, 4.14)	7.01 (5.54, 8.84)	12.65 (10.71, 114.89)
Middle	3.90 (2.80, 5.41)	5.21 (3.67, 7.33)	7.23 (5.56, 9.35)	17.58 (15.32, 20.09)
Rich	6.93 (5.23, 9.13)	6.87 (5.30, 8.86)	10.37 (8.38, 12.76)	20.17 (17.79, 22.79)
Richest	13.94 (11.30, 17.09)	9.64 (7.64, 12.10)	13.34 (11.07, 15.99)	24.95 (22.19, 27.94)
Concentration index	0.433 (0.396 to 0.469)	0.337 (0.297 to 0.377)	0.207 (0.169 to 0.246)	0.219 (0.193 to 0.245)

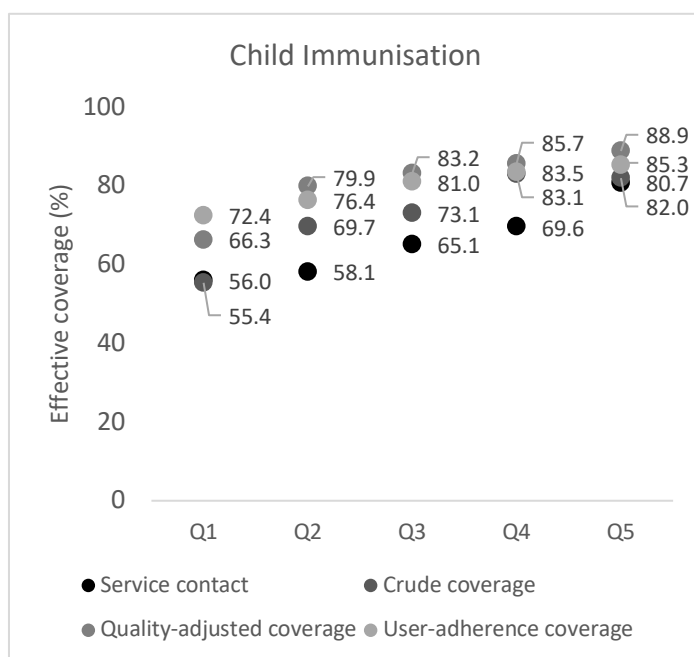
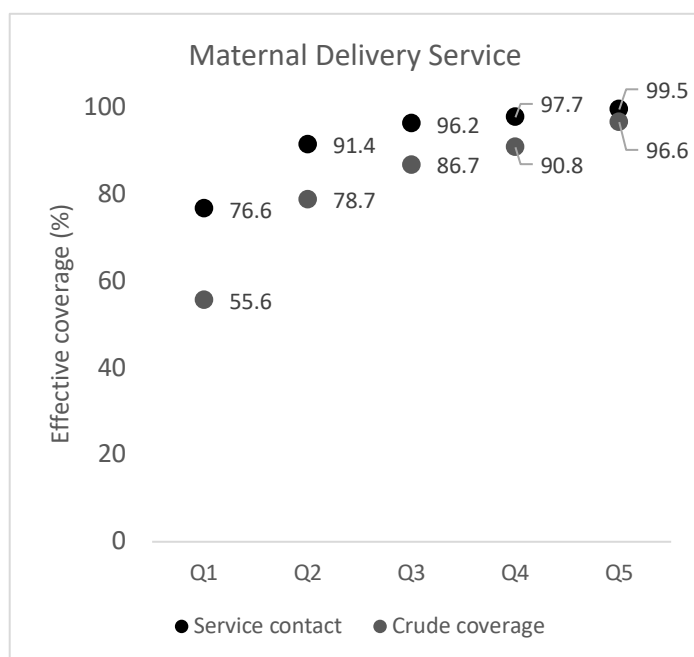
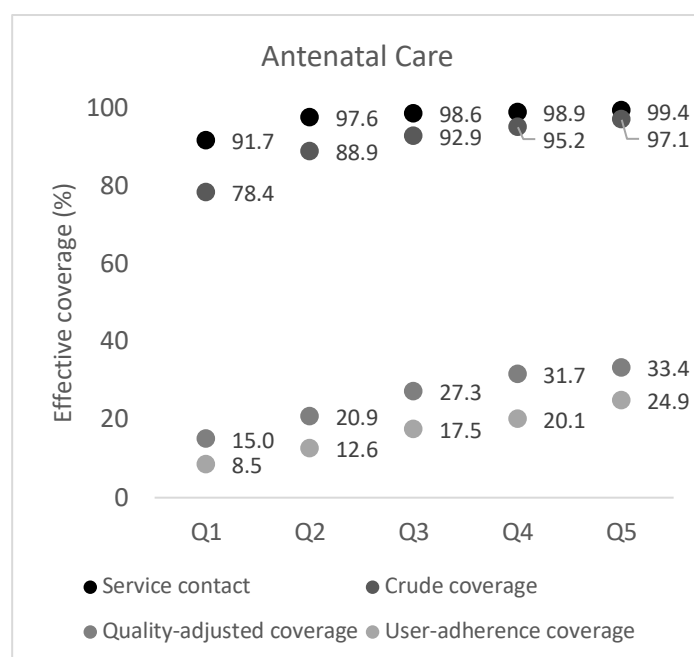
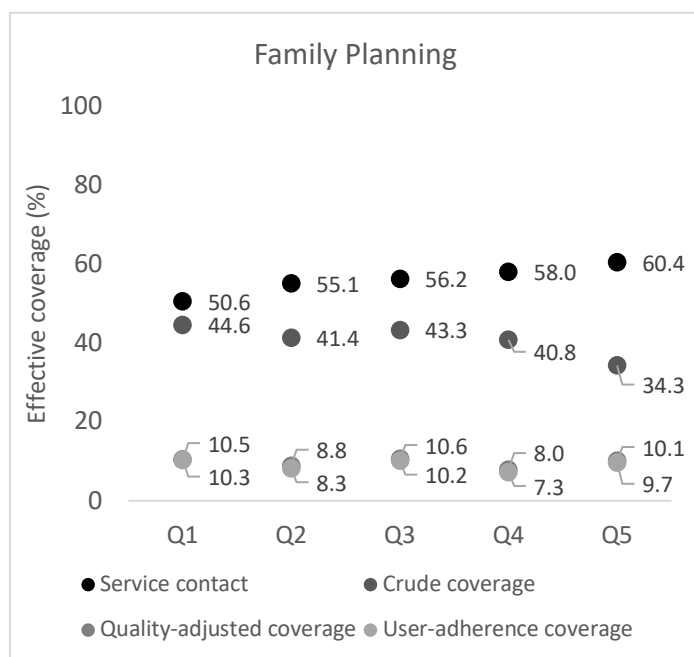
Manuscript 2 Appendix 11. Trends in wealth-based equality in maternal delivery service, 2002-2007

RMCH Indicators	IDHS 2002	IDHS 2007	IDHS 2012	IDHS 2017
Service contact				
Wealth quintile				
Poorest	41.99 (37.61, 46.50)	47.08 (43.53, 50.66)	61.06 (57.84, 64.19)	76.67 (73.37, 79.66)
Poor	58.04 (52.87, 63.04)	68.27 (63.94, 72.30)	84.17 (81.34, 86.64)	91.47 (89.34, 93.20)
Middle	68.36 (62.91, 73.34)	80.08 (76.57, 83.18)	90.80 (88.52, 92.67)	96.27 (94.94, 97.27)
Rich	84.22 (79.66, 87.92)	88.68 (85.58, 91.19)	95.58 (93.36, 97.07)	97.71 (96.54, 98.50)
Richest	95.01 (92.59, 96.67)	96.49 (94.57, 97.75)	97.75 (95.96, 98.76)	99.55 (99.04, 99.79)
Concentration index	0.168 (0.160 to 0.176)	0.154 (0.147 to 0.161)	0.107 (0.101 to 0.112)	0.053 (0.049 to 0.057)
Crude coverage				
Wealth quintile				
Poorest	12.51 (9.92, 15.66)	16.25 (13.78, 19.07)	33.06 (30.05, 36.22)	55.67 (52.21, 59.07)
Poor	25.47 (21.88, 29.43)	35.25 (30.86, 39.90)	61.22 (57.82, 64.52)	78.72 (75.95, 81.24)
Middle	38.28 (33.74, 43.04)	50.18 (45.94, 54.41)	70.52 (67.15, 73.68)	86.78 (84.51, 88.76)
Rich	55.98 (50.88, 60.96)	64.80 (60.38, 68.98)	83.30 (80.15, 86.03)	90.87 (89.09, 92.39)
Richest	83.91 (80.05, 87.14)	84.49 (81.16, 87.32)	90.00 (87.41, 92.10)	96.63 (95.55, 97.46)
Concentration index	0.374 (0.361 to 0.386)	0.334 (0.323 to 0.345)	0.215 (0.206 to 0.224)	0.114 (0.108 to 0.120)

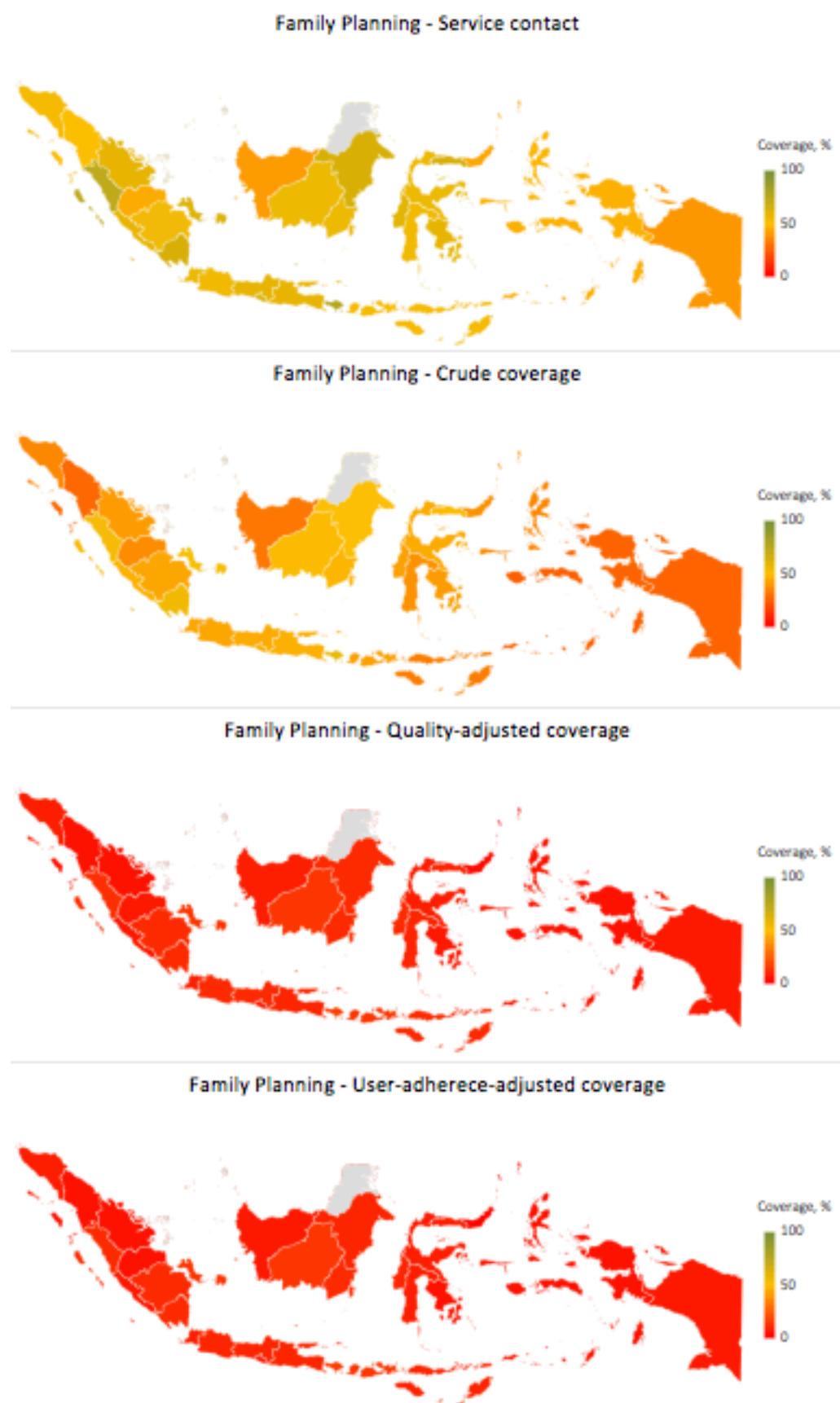
Manuscript 2 Appendix 12. Trends in wealth-based equality in child immunisation service, 2002-2007

RMCH Indicators	IDHS 2002	IDHS 2007	IDHS 2012	IDHS 2017
Service contact				
Wealth quintile				
Poorest	56.07 (51.39, 60.65)	55.41 (51.67, 59.09)	66.37 (63.19, 69.41)	72.44 (69.27, 75.40)
Poor	58.18 (51.67, 64.41)	69.76 (65.85, 73.41)	79.95 (76.61, 82.92)	76.49 (73.29, 79.42)
Middle	65.12 (59.61, 70.25)	73.11 (68.73, 77.09)	83.21 (80.08, 85.94)	81.04 (78.17, 83.60)
Rich	69.63 (64.48, 74.33)	83.10 (79.38, 86.28)	85.72 (82.90, 88.15)	83.53 (80.88, 85.89)
Richest	80.79 (75.73, 85.01)	82.05 (78.09, 85.43)	88.95 (86.40, 91.06)	85.38 (82.58, 87.80)
Concentration index	0.073 (0.064 to 0.082)	0.084 (0.075 to 0.093)	0.058 (0.051 to 0.066)	0.032 (0.025 to 0.039)
Crude coverage				
Wealth quintile				
Poorest	29.50 (25.40, 33.96)	32.81 (29.34, 36.48)	42.14 (38.99, 45.36)	51.40 (47.80, 54.98)
Poor	33.22 (28.36, 38.47)	45.07 (41.06, 49.15)	59.33 (55.39, 63.16)	58.34 (54.95, 61.65)
Middle	40.57 (35.49, 45.85)	49.67 (44.71, 54.64)	64.06 (60.18, 67.78)	62.58 (59.13, 65.91)
Rich	45.40 (40.17, 50.73)	59.60 (55.12, 63.92)	67.35 (63.41, 70.97)	66.82 (63.65, 69.85)
Richest	52.02 (46.75, 57.25)	61.52 (56.88, 65.97)	69.56 (65.62, 73.22)	68.83 (65.78, 71.72)
Concentration index	0.120 (0.104 to 0.136)	0.135 (0.121 to 0.148)	0.098 (0.087 to 0.109)	0.059 (0.048 to 0.070)
Quality-adjusted				
Wealth quintile				
Poorest	23.65 (20.34, 27.32)	25.29 (22.19, 28.67)	31.58 (28.84, 34.46)	38.89 (35.67, 42.21)
Poor	27.17 (22.86, 31.95)	33.95 (30.23, 37.87)	46.26 (42.31, 50.25)	42.77 (39.54, 46.06)
Middle	33.27 (28.71, 38.17)	36.98 (32.34, 41.88)	47.89 (43.95, 51.86)	45.62 (42.31, 48.97)
Rich	36.54 (31.62, 41.75)	44.80 (40.40, 49.29)	48.52 (44.22, 52.84)	47.83 (44.70, 50.97)
Richest	38.87 (34.75, 43.15)	46.22 (41.73, 50.77)	54.80 (50.58, 58.96)	48.77 (45.53, 52.02)
Concentration index	0.112 (0.094 to 0.131)	0.126 (0.109 to 0.143)	0.097 (0.082 to 0.112)	0.044 (0.029 to 0.059)
User-adherence-adjusted				
Wealth quintile				
Poorest	0.78 (0.48, 1.26)	1.76 (1.10, 2.82)	3.18 (2.13, 4.73)	4.80 (3.63, 6.32)
Poor	1.78 (0.98, 3.23)	2.87 (1.68, 4.88)	6.72 (5.06, 8.88)	6.23 (4.81, 8.05)
Middle	4.94 (3.01, 8.00)	4.09 (2.26, 7.30)	5.80 (4.21, 7.95)	9.07 (7.32, 11.19)
Rich	3.75 (2.15, 6.47)	4.35 (2.87, 6.55)	8.78 (6.68, 11.47)	8.67 (6.95, 10.77)
Richest	2.91 (1.76, 4.79)	3.88 (2.45, 6.10)	11.76 (9.21, 14.89)	9.82 (7.93, 12.09)
Concentration index	0.239 (0.169 to 0.309)	0.159 (0.086 to 0.232)	0.221 (0.171 to 0.271)	0.152 (0.104 to 0.199)

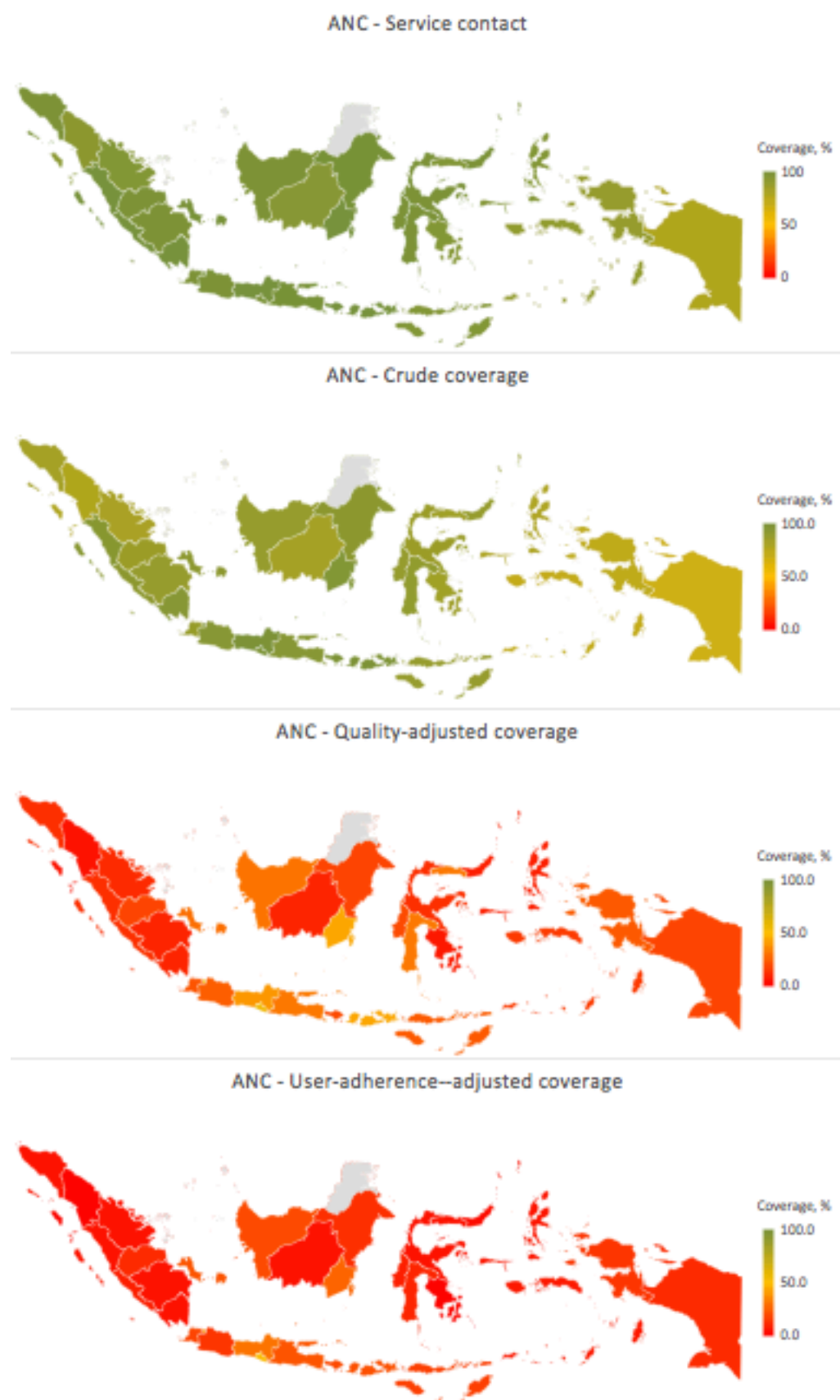
Manuscript 2 Appendix 13. RMCH coverage levels, by wealth quintile 2017



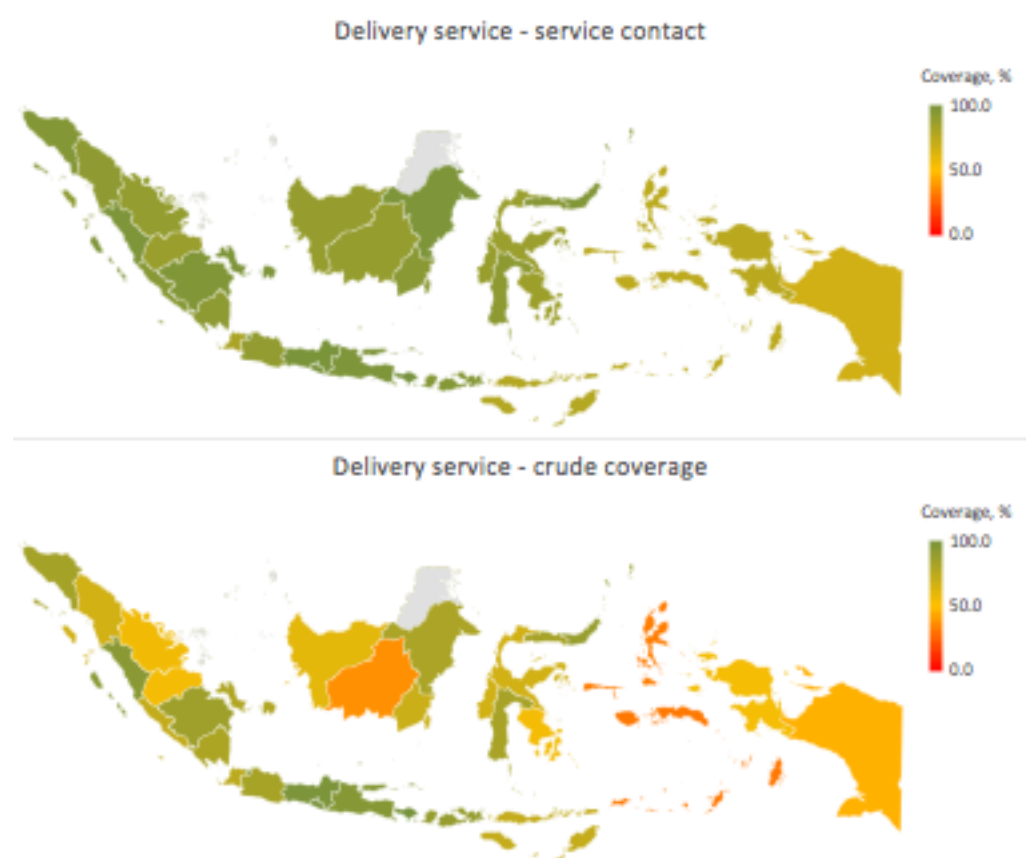
Manuscript 2 Appendix 14. Family planning coverage according to effective coverage cascade, by province 2017



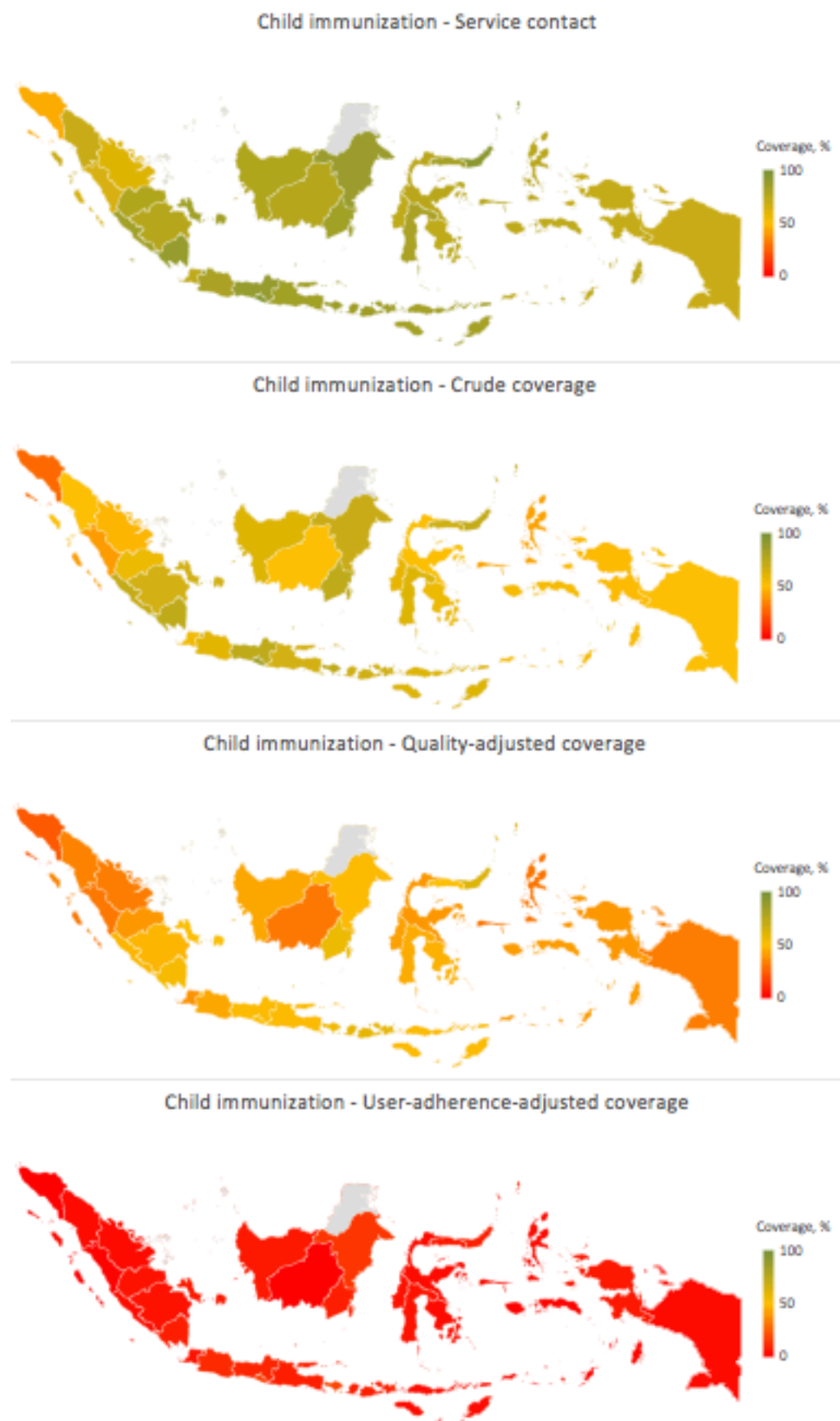
Manuscript 2 Appendix 15. Antenatal care coverage according to effective coverage cascade, by province 2017



Manuscript 2 Appendix 16. Maternal delivery service coverage according to effective coverage cascade, by province 2017



Manuscript 2 Appendix 17. Child immunisation coverage according to effective coverage cascade, by province 2017



Manuscript 2 Appendix 18. Province grouping based on 2017 provincial crude coverage level (family planning)

<40%	40-44%	>45%
Aceh	Riau	West Sumatra
North Sumatra	South Sumatra	Bengkulu
Jambi	West Java	Lampung
Riau Islands	Central Java	Bangka Belitung
Jakarta	Banten	Yogyakarta
East Nusa Tenggara	West Nusa Tenggara	East Java
West Kalimantan	Central Sulawesi	Bali
North Sulawesi	West Sulawesi	Central Kalimantan
South Sulawesi		South Kalimantan
Southeast Sulawesi		East Kalimantan
Maluku		North Kalimantan
North Maluku		Gorontalo
West Papua		
Papua		

Manuscript 2 Appendix 19. Province grouping based on 2017 provincial crude coverage level (antenatal care)

<80%	80-89%	>90%
North Sumatra	Aceh	West Sumatra
Maluku	Riau	Bengkulu
North Maluku	Jambi	Lampung
West Papua	South Sumatra	Bangka Belitung
Papua	Riau islands	Jakarta
	Banten	West Java
	East Nusa Tenggara	Central Java
	West Kalimantan	Yogyakarta
	Central Kalimantan	East Java
	North Kalimantan	Bali
	North Sulawesi	West Nusa Tenggara
	Central Sulawesi	South Kalimantan
	South Sulawesi	East Kalimantan
	Southeast Sulawesi	
	Gorontalo	
	West Sulawesi	

Manuscript 2 Appendix 20. Province grouping based on 2017 provincial crude coverage level (maternal delivery)

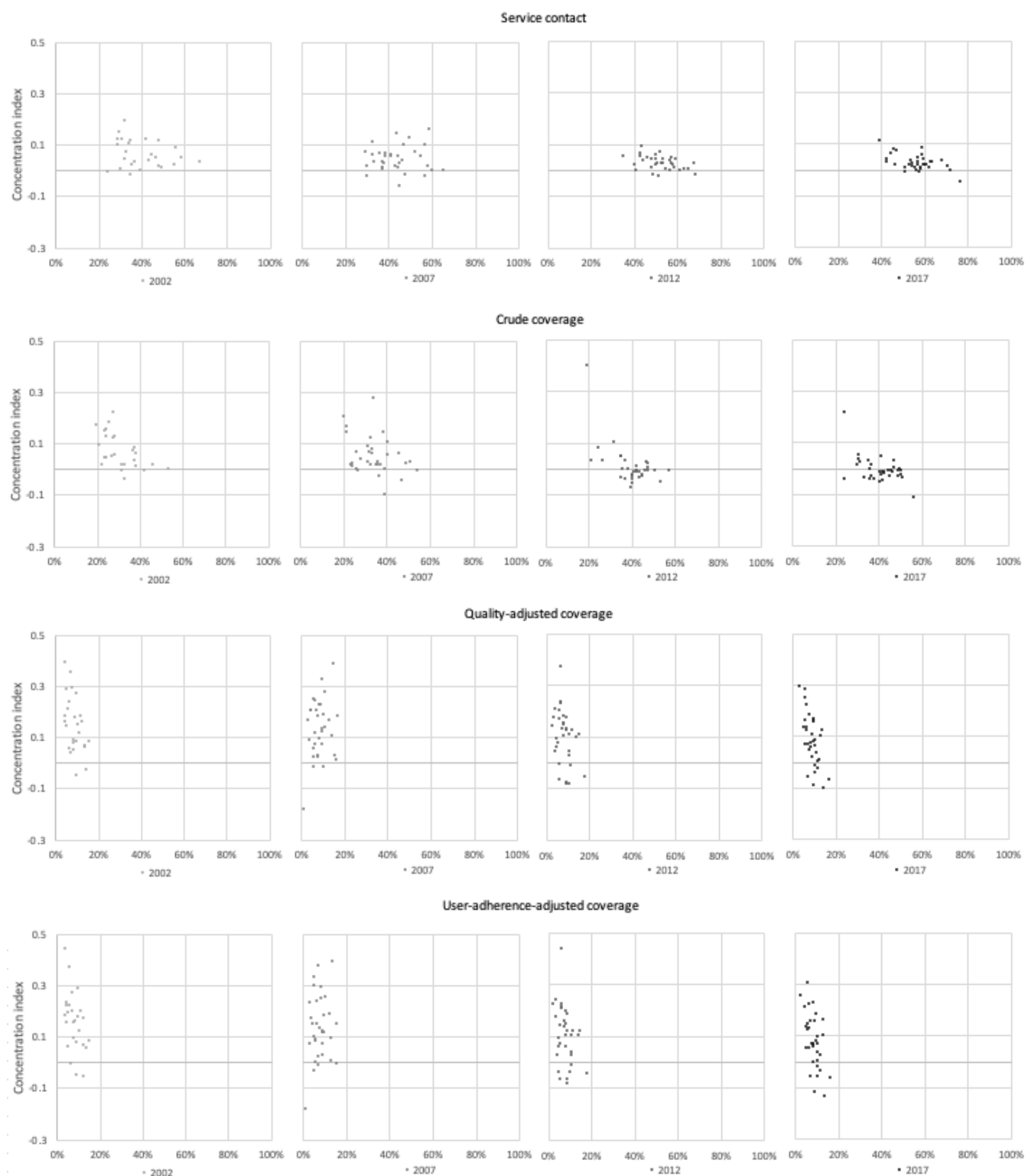
<80%	80-89%	>90%
North Sumatra	Aceh	West Sumatra
Riau	South Sumatra	Riau Islands
Jambi	Lampung	Jakarta
Bengkulu	Bangka Belitung	Central Java
Banten	West Java	Yogyakarta
East Nusa Tenggara	East Kalimantan	East Java
West Kalimantan	North Kalimantan	Bali
Central Kalimantan	North Sulawesi	West Nusa Tenggara
South Kalimantan	South Sulawesi	
Central Sulawesi	Gorontalo	

Southeast Sulawesi		
West Sulawesi		
Maluku		
North Maluku		
West Papua		
Papua		

Manuscript 2 Appendix 21. Province grouping based on 2017 provincial crude coverage level (childhood immunisation)

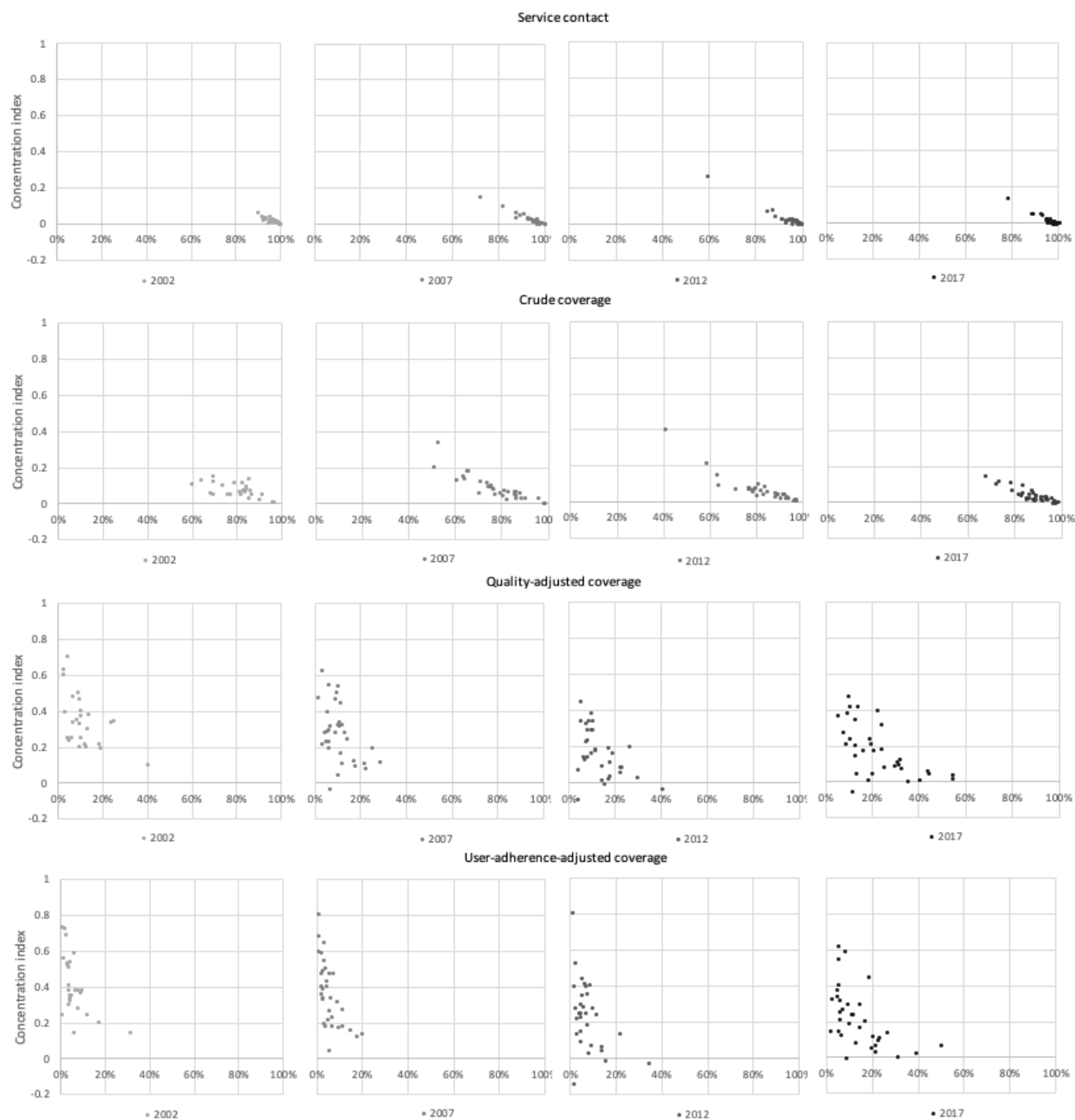
<60%	60-69%	>70%
Aceh	South Sumatra	Bengkulu
North Sumatra	Bangka Belitung	Lampung
West Sumatra	Riau Islands	Central Java
Riau	Jakarta	Yogyakarta
Jambi	West Java	Bali
Banten	East Java	South Kalimantan
Central Kalimantan	West Nusa Tenggara	North Sulawesi
Central Sulawesi	East Nusa Tenggara	
Southeast Sulawesi	West Kalimantan	
West Sulawesi	East Kalimantan	
Maluku	North Kalimantan	
North Maluku	South Sulawesi	
West Papua	Gorontalo	
Papua		

Manuscript 2 Appendix 22. Family planning coverage and concentration index by province

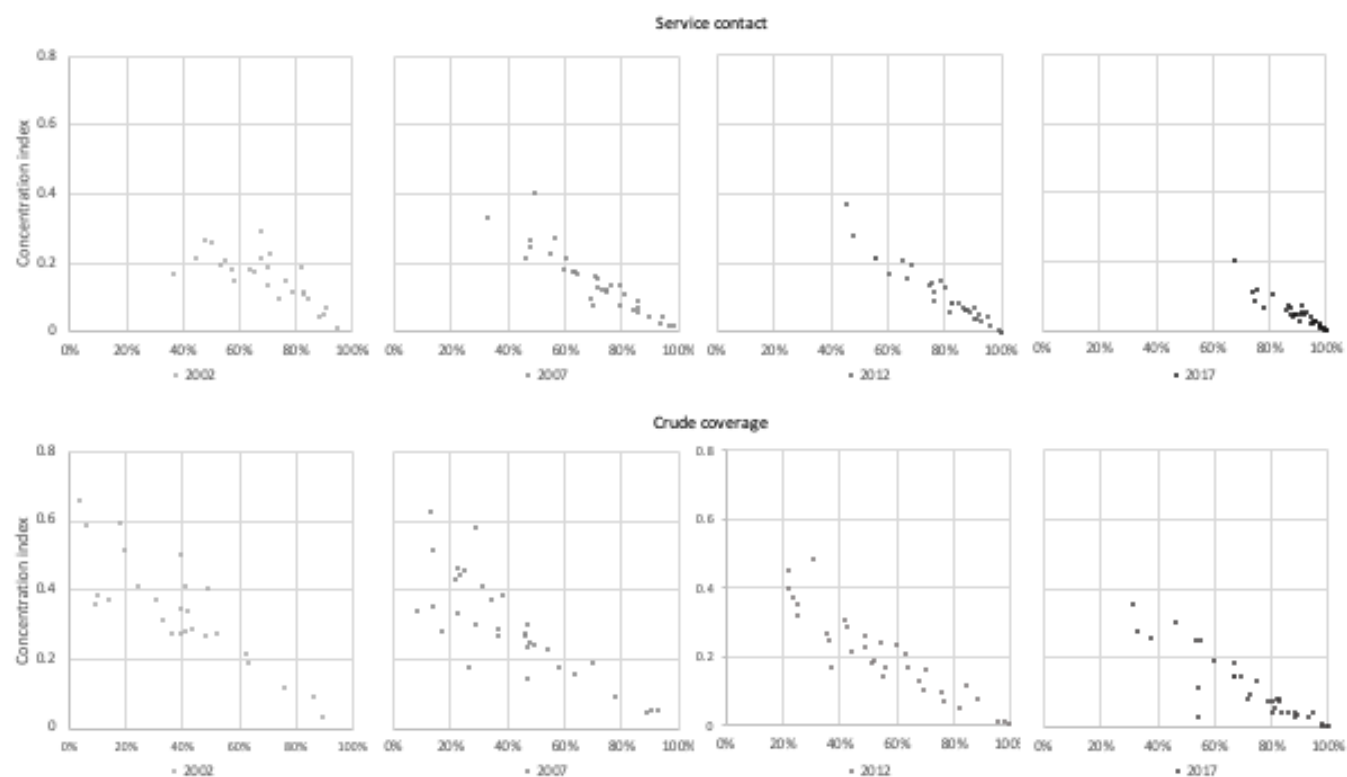


from 2002-2017 DHS

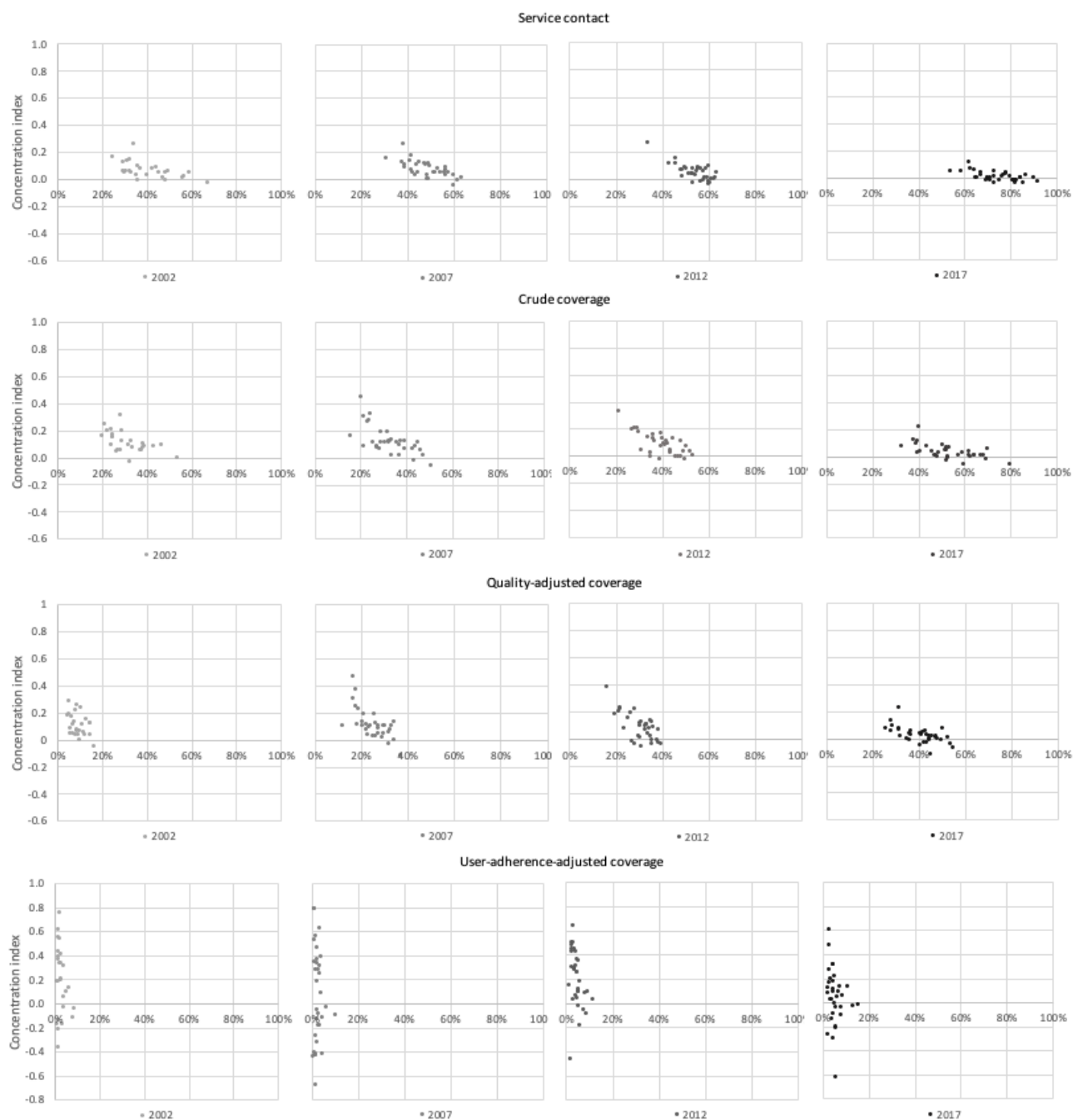
Manuscript 2 Appendix 23. Antenatal care coverage and concentration index by province from 2002-2017 DHS



Manuscript 2 Appendix . Maternal delivery coverage and concentration index by province from 2002-2017 DHS

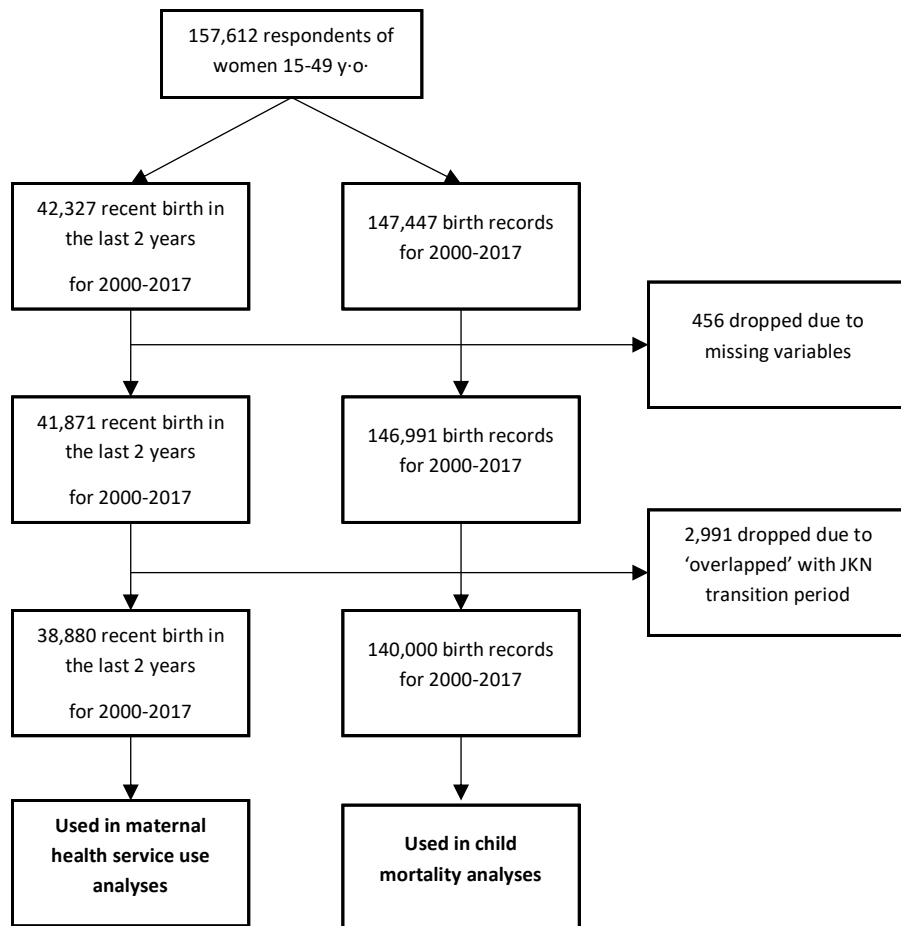


Manuscript 2 Appendix 24. Childhood immunization coverage and concentration index by province from 2002-2017 DHS



Appendix 3: Supplementary materials for Manuscript 3

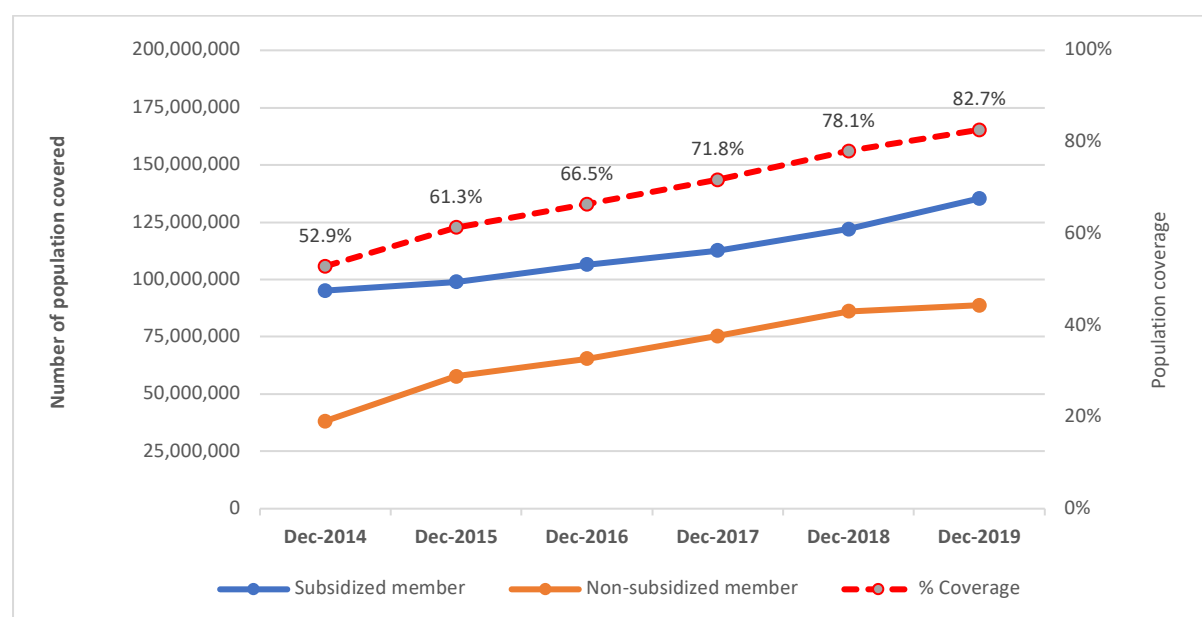
Manuscript 3 Appendix 1. Sample flowchart



Manuscript 3 Appendix 2. List of covariates

Covariates	Type of variable	Coding
Wealth quintile	Categorical ordinal	0 – Q1 (lowest) 1 – Q2 2 – Q3 3 – Q4 4 – Q5 (highest)
Age (in years)	Categorical ordinal	0 – 15-25 years 1 – 26-35 years 2 – 36-42 years 3 – 42-49 years
Marital status	Binary	0 – Not married 1 – Married
Parity level	Binary	0 – One child 1 – two or more children
Women's education	Categorical ordinal	0 – None 1 – Completed primary school 2 – Completed secondary school 3 – Completed post-secondary school
Women's occupation	Categorical nominal	0 – None 1 – Agricultural 2 – Blue-collar 3 – White-collar
Type of residency	Binary	0 – rural 1 – urban
Region of residency	Categorical nominal	0 – Java-Bali 1 – Sumatera 2 – Kalimantan 3 – Sulawesi 4 – Eastern Indonesia (includes Nusa Tenggara, Maluku and Papua)
Months (dummy)	Categorical nominal	0 – January to March 1 – April to June 2 – July to September 3 – October to December

Manuscript 3 Appendix 3. Population coverage of JKN by types of membership, 2014-2019



Manuscript 3 Appendix 4. Sample characteristics from four DHS waves

Variable	Total (N=38,880) %	2002 (N=9,052) %	2007 (N=10,217) %	2012 (N=10,099) %	2017 (N=9,512) %
Asset quintiles					
Poorest	21.3	22.5	22.1	20.7	20.1
Poor	19.9	19.2	19.3	20.0	21.0
Middle	20.0	19.8	20.6	19.9	19.8
Rich	20.0	19.8	18.9	21.0	20.3
Richest	18.8	18.7	19.1	18.4	18.9
Age at delivery (%)					
15 – 25 years	38.2	42.6	40.3	37.9	32.1
26 – 35 years	47.3	44.7	46.0	47.5	51.0
36 – 42 years	13.0	11.5	12.1	13.2	15.2
42 – 49 years	1.5	1.2	1.6	1.4	1.7
Marital status (%)					
Unmarried	2.5	1.6	2.1	3.0	3.2
Married	97.5	98.4	97.9	97.0	97.5
Parity					
1 child	33.8	38.1	36.2	29.5	31.8
2 or more children	66.2	61.9	63.8	70.5	68.2
Education (%)					
None	2.6	4.6	3.1	2.0	1.0
Primary	35.3	47.0	40.2	30.8	24.3
Secondary	51.2	42.2	48.4	54.6	58.4
Post-secondary	11.0	6.3	8.3	12.6	16.4
Women's occupation (%)					
None	55.8	63.4	54.9	51.9	53.8
Agriculture	12.1	15.5	15.7	9.7	7.6
Blue-collar	24.0	16.4	23.8	28.2	27.0
White-collar	8.1	4.7	5.7	10.1	11.6
Residency (%)					
Rural	53.5	52.7	58.6	50.9	51.7
Urban	46.6	47.3	41.4	49.1	48.3
Region of residency (%)					
Java-Bali	56.0	57.0	55.2	55.9	55.7
Sumatera	22.5	22.7	21.8	22.5	22.9
Kalimantan	6.5	6.9	6.6	6.4	6.2
Sulawesi	7.9	8.9	8.4	7.4	7.2
Eastern Indonesia	7.1	4.6	8.0	7.7	8.0

Manuscript 3 Appendix 5. Outcome variables based on survey waves

Variable	Total	Survey waves			
	n (%)	2002 n (%)	2007 n (%)	2012 n (%)	2017 n (%)
Maternal health care use	(N=38,880)	(N=9,052)	(N=10,217)	(N=10,099)	(N=9,512)
At least 4 times antenatal	31,974 (82.2)	7,185 (79.4)	7,934 (77.7)	8,456 (83.7)	8,399 (88.3)
Skilled birth attendance	30,380 (78.1)	6,207 (68.6)	7,303 (71.5)	8,232 (81.5)	8,638 (90.8)
Institutional delivery	21,035 (54.1)	3,504 (38.7)	4,327 (42.4)	5,900 (58.4)	7,304 (76.8)
Caesarean section	4,148 (10.7)	376 (4.2)	762 (7.5)	1,300 (12.9)	1,710 (17.9)
Child mortality	(N = 144,000)	(N = 9,982)	(N = 28,825)	(N = 45,250)	(N = 62,934)
Neonatal death	3,134 (2.1)	182 (1.8)	667 (2.3)	1,020 (2.3)	1,265 (2.0)
Infant death	5,384 (3.7)	336 (3.4)	1,162 (4.0)	1,740 (3.9)	2,146 (3.4)

Manuscript 3 Appendix 6. Estimation of mortality rates. Rates refer to the 5-year period preceding each survey

The conventional approach used in the DHS in estimating neonatal and infant mortality rates based on birth histories gathered from women aged 15-49 years. We applied a direct methods of mortality-estimation using Stata package ‘syncmrates’ to emulate the approach used in the DHS reports. Using the setting, this approach provides mortality estimates for the 5-year period for each data point that is in line with the DHS approach with calculation of bootstrapped 95% confidence intervals. (Edoardo Masset, 2016. “SYNCMRATES: Stata module to compute child mortality rates using synthetic cohort probabilities”. Boston College Department of Economics. <https://ideas.repec.org/c/boc/bocode/s458149.html>).

Manuscript 3 Appendix 7. Intra-class correlation from the multilevel logistic regression of province on maternal health services utilization and child mortality

	Antenatal Care 4+	Skilled birth attendance	Facility delivery	Caesarean section	Neonatal death	Infant death
Provincial variance (estimate and s.e.)	0.17 (0.04)	0.30 (0.08)	0.68 (0.17)	0.05 (0.01)	0.02 (0.01)	0.02 (0.01)
Intra class correlation (ICC), %	5.0	8.3	17.1	1.4	0.7	1.0

Note: All models are controlled for individual (wealth, age, parity, marital status, education level, occupation) level characteristics as well as urban-rural and region of residence.

Manuscript 3 Appendix 8. Multilevel logit regression of association between JKN and maternal health services utilization of a pooled sampled 2000-2017

Variable	ANC 4+				Skilled birth attendance				Institutional delivery				Caesarean section			
	Adjusted OR	95% CI		p-value	Adjusted OR	95% CI		p-value	Adjusted OR	95% CI		p-value	Adjusted OR	95% CI		p-value
Time (year quarterly)	1.01	1.00	1.01	0.00	1.02	1.02	1.02	0.00	1.03	1.03	1.03	0.00	1.03	1.03	1.03	0.00
JKN policy	1.81	1.44	2.27	0.00	1.83	1.42	2.36	0.00	1.45	1.20	1.75	0.00	0.91	0.75	1.11	0.37
Time after policy (quarter)	0.97	0.95	0.99	0.00	1.00	0.97	1.02	0.89	1.02	1.00	1.04	0.02	0.98	0.96	1.00	0.04
Asset quintiles (Poorest as reference)																
Poor	1.60	1.48	1.73	0.00	1.90	1.76	2.05	0.00	1.69	1.57	1.83	0.00	1.73	1.51	2.00	0.00
Middle	2.02	1.84	2.22	0.00	3.01	2.74	3.32	0.00	2.25	2.07	2.45	0.00	1.99	1.72	2.30	0.00
Rich	3.01	2.68	3.38	0.00	5.31	4.68	6.02	0.00	3.35	3.05	3.68	0.00	2.71	2.34	3.14	0.00
Richest	5.34	4.52	6.30	0.00	11.74	9.65	14.28	0.00	6.19	5.51	6.96	0.00	3.68	3.16	4.29	0.00
Age at delivery (15-25 as reference)																
26-35 years	1.49	1.39	1.61	0.00	1.54	1.43	1.66	0.00	1.45	1.36	1.55	0.00	1.52	1.40	1.66	0.00
36 – 42 years	1.34	1.21	1.50	0.00	1.80	1.61	2.02	0.00	2.00	1.80	2.21	0.00	2.76	2.44	3.13	0.00
42 – 49 years	1.28	1.01	1.62	0.04	1.78	1.39	2.29	0.00	2.12	1.67	2.71	0.00	2.93	2.17	3.96	0.00
Marital status (not-married as reference)																
Married	1.90	1.65	2.18	0.00	1.23	1.06	1.43	0.01	1.06	0.91	1.22	0.46	1.02	0.81	1.28	0.86
Parity (1 child as reference)																
2 or more children	1.71	1.59	1.84	0.00	2.17	1.67	1.94	0.00	1.71	1.60	1.83	0.00	1.68	1.53	1.84	0.00
Education (none as reference)																
Primary	2.24	1.96	2.56	0.00	2.17	1.88	2.51	0.00	1.82	1.51	2.19	0.00	1.77	1.13	2.77	0.01
Secondary	3.85	3.35	4.43	0.00	4.78	4.11	5.56	0.00	3.32	2.75	4.01	0.00	2.46	1.57	3.84	0.00
Post-secondary	4.65	3.75	5.75	0.00	9.47	7.28	12.33	0.00	4.91	3.93	6.12	0.00	4.00	2.54	6.32	0.00
Women's occupation (none as reference)																
Agriculture	0.84	0.78	0.91	0.00	0.67	0.62	0.73	0.00	0.68	0.63	0.74	0.00	0.67	0.57	0.80	0.00
Blue-collar	1.18	1.09	1.27	0.00	1.08	1.00	1.17	0.06	1.05	0.99	1.13	0.12	0.96	0.89	1.05	0.40
White-collar	1.35	1.13	1.63	0.00	1.37	1.10	1.70	0.01	1.00	0.88	1.13	0.96	1.10	0.98	1.23	0.12
Residency (rural as reference)																
Urban	1.16	1.08	1.25	0.00	1.74	1.61	1.88	0.00	2.83	2.66	3.01	0.00	1.42	1.31	1.55	0.00
Region of residency (Java-Bali as reference)																
Sumatera	0.53	0.35	0.81	0.00	1.31	0.76	2.25	0.33	0.38	0.17	0.84	0.02	1.14	0.91	1.44	0.26
Kalimantan	0.59	0.35	0.97	0.04	0.78	0.41	1.48	0.44	0.20	0.08	0.52	0.00	0.82	0.61	1.09	0.17
Sulawesi	0.41	0.26	0.65	0.00	0.65	0.35	1.20	0.17	0.23	0.09	0.57	0.00	0.89	0.68	1.16	0.38
Eastern Indonesia	0.43	0.27	0.68	0.00	0.39	0.21	0.71	0.00	0.22	0.09	0.54	0.00	0.81	0.62	1.07	0.14
Months (dummy)																
January - March	0.97	0.90	1.06	0.54	1.03	0.95	1.12	0.45	0.98	0.91	1.06	0.65	1.02	0.92	1.12	0.71
April - June	0.98	0.90	1.06	0.60	1.03	0.94	1.11	0.55	1.00	0.93	1.08	1.00	0.91	0.83	1.00	0.06
July - September	1.04	0.96	1.13	0.35	1.02	0.94	1.10	0.71	1.02	0.94	1.10	0.68	1.00	0.91	1.10	0.98
October - December	(omitted)				(omitted)				(omitted)				(omitted)			
Random Parameters																
Level-2: Between-province variation	Est.	s.e.	95% CI		Est.	s.e.	95% CI		Est.	s.e.	95% CI		Est.	s.e.	95% CI	
	0.17	0.04	0.11	0.29	0.30	0.08	0.18	0.49	0.68	0.17	0.42	1.10	0.05	0.01	0.03	0.09

Manuscript 3 Appendix 9. Multilevel logit regression of association between JKN and child mortality of a pooled sampled of the year 2000-2017

Variable	Neonatal mortality				Infant mortality			
	Adjusted OR (95%CI)	95% CI		p-value	Adjusted OR (95%CI)	95% CI	p-value	
Time	1.00	0.99	1.01	0.47	0.98	0.97	0.99	0.00
Policy process	0.96	0.56	1.65	0.87	1.05	0.67	1.63	0.84
Time after policy (year)	0.99	0.82	1.19	0.89	0.97	0.83	1.13	0.71
Asset quintiles (Poorest as reference)								
Poor	0.84	0.76	0.93	0.00	0.78	0.72	0.84	0.00
Middle	0.87	0.77	0.98	0.02	0.74	0.67	0.81	0.00
Rich	0.78	0.68	0.89	0.00	0.66	0.59	0.73	0.00
Richest	0.63	0.54	0.74	0.00	0.53	0.47	0.60	0.00
Age at delivery (15-25 as reference)								
26-35 years	0.60	0.56	0.66	0.00	0.65	0.61	0.69	0.00
36 – 42 years	0.71	0.63	0.81	0.00	0.74	0.67	0.81	0.00
42 – 49 years	1.18	0.84	1.64	0.34	1.04	0.79	1.37	0.79
Marital status (not-married as reference)								
Married	0.83	0.71	0.97	0.02	0.80	0.71	0.90	0.00
Parity (1 child as reference)								
2 or more children	0.40	0.36	0.43	0.00	0.38	0.36	0.41	0.00
Education (none as reference)								
Primary	0.88	0.74	1.04	0.12	0.80	0.71	0.91	0.00
Secondary	0.79	0.67	0.94	0.01	0.68	0.60	0.77	0.00
Post-secondary	0.75	0.58	0.95	0.02	0.63	0.52	0.77	0.00
Women’s occupation (none as reference)								
Agriculture	1.04	0.94	1.15	0.48	1.10	1.02	1.19	0.02
Blue-collar	1.03	0.95	1.13	0.48	1.03	0.96	1.10	0.43
White-collar	1.18	0.99	1.41	0.07	1.18	1.02	1.36	0.03
Residency (rural as reference)								
Urban	1.02	0.93	1.11	0.74	0.98	0.92	1.05	0.62
Region of residency (Java-Bali as reference)								
Sumatera	1.00	0.83	1.21	0.99	0.94	0.80	1.11	0.46
Kalimantan	0.99	0.79	1.25	0.96	0.93	0.76	1.14	0.49
Sulawesi	1.04	0.84	1.29	0.71	1.13	0.94	1.36	0.20
Eastern Indonesia	1.00	0.81	1.23	0.97	1.09	0.91	1.31	0.34
Season dummy								
January - March	1.15	1.03	1.27	0.01	1.14	1.05	1.24	0.00
April - June	1.10	0.99	1.22	0.07	1.12	1.03	1.21	0.01
July - September	1.07	0.97	1.19	0.19	1.14	1.05	1.23	0.00
October - December	(omitted)				(omitted)			
Random Parameters	Est.	s.e.	95% CI		Est.	s.e.	95% CI	
Level-2: Between-province variation	0.02	0.01	0.01	0.05	0.02	0.01	0.01	0.04

Manuscript 3 Appendix 10. Logistic regression for Models A-B testing different interaction terms for the association between JKN and antenatal care 4+

Variable	Antenatal Care 4+							
	Model B				Model C			
	Adjusted OR (95%CI)	95% CI		p-value	Adjusted OR (95%CI)	95% CI		p-value
Time (year quarterly)	1.01	1.00	1.01	0.00	1.01	1.00	1.01	0.00
JKN policy	1.90	1.38	2.62	0.00	1.96	1.14	3.40	0.02
Time after policy (quarter)	0.98	0.95	1.01	0.11	0.96	0.91	1.01	0.14
Asset quintiles (Poorest as reference)								
Poor	1.64	1.51	1.78	0.00	1.60	1.48	1.73	0.00
Middle	2.06	1.87	2.28	0.00	2.03	1.85	2.22	0.00
Rich	3.21	2.83	3.65	0.00	3.02	2.69	3.39	0.00
Richest	6.27	5.19	7.56	0.00	5.35	4.54	6.32	0.00
Age at delivery (15-25 as reference)								
26-35 years	1.49	1.38	1.61	0.00	1.50	1.39	1.61	0.00
36 – 42 years	1.34	1.20	1.49	0.00	1.34	1.21	1.50	0.00
42 – 49 years	1.28	1.01	1.62	0.04	1.28	1.01	1.61	0.04
Marital status (not-married as reference)								
Married	1.92	1.66	2.21	0.00	1.91	1.66	2.20	0.00
Parity (1 child as reference)								
2 or more children	1.71	1.59	1.84	0.00	1.71	1.59	1.84	0.00
Education (none as reference)								
Primary	2.23	1.95	2.55	0.00	2.23	1.95	2.55	0.00
Secondary	3.83	3.33	4.41	0.00	3.84	3.34	4.42	0.00
Post-secondary	4.74	3.83	5.87	0.00	4.64	3.75	5.75	0.00
Women's occupation (none as reference)								
Agriculture	0.84	0.78	0.91	0.00	0.83	0.77	0.90	0.00
Blue-collar	1.18	1.09	1.28	0.00	1.17	1.08	1.27	0.00
White-collar	1.36	1.14	1.64	0.00	1.35	1.12	1.62	0.00
Residency (rural as reference)								
Urban	1.16	1.08	1.25	0.00	1.16	1.08	1.25	0.00
Region of residency (Java-Bali as reference)								
Sumatera	0.54	0.35	0.81	0.00	0.56	0.37	0.85	0.01
Kalimantan	0.59	0.36	0.98	0.04	0.59	0.35	0.97	0.04
Sulawesi	0.41	0.26	0.66	0.00	0.39	0.24	0.62	0.00
Eastern Indonesia	0.43	0.27	0.68	0.00	0.42	0.26	0.67	0.00
Season dummy								
January - March	0.97	0.90	1.06	0.54	0.97	0.89	1.05	0.48
April - June	0.98	0.90	1.06	0.60	0.98	0.90	1.06	0.56
July - September	1.04	0.96	1.13	0.37	1.04	0.96	1.13	0.38
October - December								
Wealth x Policy Process interaction								
Quintile 2 x Policy Process	1.52	0.86	2.67	0.15				
Quintile 3 x Policy Process	0.53	0.28	0.98	0.04				
Quintile 4 x Policy Process	0.97	0.44	2.12	0.94				
Quintile 5 x Policy Process	0.36	0.14	0.91	0.03				
Wealth x Year-after-policy interaction								
Quintile 2 x Year-after-policy	0.95	0.90	1.00	0.04				
Quintile 3 x Year-after-policy	1.06	0.99	1.12	0.08				
Quintile 4 x Year-after-policy	0.97	0.90	1.04	0.40				
Quintile 5 x Year-after-policy	1.03	0.94	1.12	0.55				
Region x Policy Process interaction								
Sumatera x Policy Process					0.60	0.31	1.17	0.14
Kalimantan x Policy Process					0.74	0.31	1.80	0.51
Sulawesi x Policy Process					1.61	0.75	3.46	0.23
Eastern Indonesia x Policy Process					1.05	0.52	2.11	0.89
Region x Year-after-policy interaction								
Sumatera x Year-after-policy					1.02	0.95	1.08	0.60
Kalimantan x Year-after-policy					1.03	0.95	1.12	0.47
Sulawesi x Year-after-policy					0.99	0.92	1.07	0.82
Eastern Indonesia x Year-after-policy					1.01	0.94	1.07	0.87
Random Parameters	Est.	s.e.	95% CI		s.e.	95% CI		Est.
Level-2: Between-province variation	0.17	0.04	0.11	0.29	0.17	0.04	0.10	0.28

Manuscript 3 Appendix 11. Logistic regression for Models A-B testing different interaction terms for the association between JKN and skilled birth attendance

Variable	Skilled Birth Attendance							
	Model B				Model C			
	Adjusted OR (95%CI)	95% CI	P-value		Adjusted OR (95%CI)	95% CI	P-value	
Time (year quarterly)	1.02	1.02	1.02	0.00	1.02	1.02	1.02	0.00
JKN policy	1.86	1.36	2.56	0.00	1.40	0.81	2.41	0.22
Time after policy (quarter)	0.99	0.96	1.02	0.61	1.05	0.99	1.11	0.12
Asset quintiles (Poorest as reference)								
Poor	1.88	1.73	2.03	0.00	1.90	1.77	2.06	0.00
Middle	2.95	2.67	3.26	0.00	3.03	2.75	3.33	0.00
Rich	5.25	4.61	5.99	0.00	5.34	4.71	6.06	0.00
Richest	11.78	9.61	14.45	0.00	11.87	9.75	14.45	0.00
Age at delivery (15-25 as reference)								
26-35 years	1.54	1.43	1.66	0.00	1.54	1.43	1.67	0.00
36 – 42 years	1.80	1.61	2.01	0.00	1.80	1.60	2.01	0.00
42 – 49 years	1.79	1.39	2.29	0.00	1.77	1.38	2.27	0.00
Marital status (not-married as reference)								
Married	1.23	1.05	1.43	0.01	1.22	1.05	1.42	0.01
Parity (1 child as reference)								
2 or more children	1.80	1.66	1.94	0.00	1.80	1.66	1.94	0.00
Education (none as reference)								
Primary	2.17	1.88	2.51	0.00	2.16	1.87	2.50	0.00
Secondary	4.78	4.11	5.55	0.00	4.77	4.11	5.55	0.00
Post-secondary	9.46	7.26	12.32	0.00	9.48	7.28	12.34	0.00
Women's occupation (none as reference)								
Agriculture	0.67	0.62	0.73	0.00	0.67	0.62	0.73	0.00
Blue-collar	1.08	1.00	1.17	0.06	1.08	1.00	1.17	0.06
White-collar	1.36	1.10	1.70	0.01	1.36	1.09	1.69	0.01
Residency (rural as reference)								
Urban	1.73	1.60	1.87	0.00	1.73	1.60	1.87	0.00
Region of residency (Java-Bali as reference)								
Sumatera	1.31	0.76	2.25	0.33	1.39	0.80	2.39	0.24
Kalimantan	0.77	0.40	1.48	0.44	0.81	0.42	1.57	0.54
Sulawesi	0.65	0.35	1.20	0.17	0.64	0.35	1.18	0.15
Eastern Indonesia	0.39	0.21	0.72	0.00	0.40	0.21	0.73	0.00
Season dummy								
January - March	1.03	0.95	1.12	0.45	1.03	0.95	1.12	0.50
April - June	1.03	0.94	1.11	0.55	1.02	0.94	1.11	0.58
July - September	1.02	0.94	1.10	0.70	1.01	0.93	1.10	0.73
October - December								
Wealth x Policy Process interaction								
Quintile 2 x Policy Process	1.29	0.70	2.40	0.42				
Quintile 3 x Policy Process	0.80	0.35	1.84	0.60				
Quintile 4 x Policy Process	0.56	0.18	1.70	0.30				
Quintile 5 x Policy Process	0.22	0.04	1.31	0.10				
Wealth x Year-after-policy interaction								
Quintile 2 x Year-after-policy	0.98	0.93	1.05	0.60				
Quintile 3 x Year-after-policy	1.05	0.96	1.14	0.31				
Quintile 4 x Year-after-policy	1.08	0.96	1.21	0.22				
Quintile 5 x Year-after-policy	1.17	0.96	1.44	0.12				
Region x Policy Process interaction								
Sumatera x Policy Process					0.78	0.36	1.67	0.52
Kalimantan x Policy Process					1.00	0.39	2.60	1.00
Sulawesi x Policy Process					1.74	0.79	3.85	0.17
Eastern Indonesia x Policy Process					1.81	0.91	3.58	0.09
Region x Year-after-policy interaction								
Sumatera x Year-after-policy					0.97	0.89	1.04	0.38
Kalimantan x Year-after-policy					0.97	0.88	1.07	0.53
Sulawesi x Year-after-policy					0.96	0.88	1.04	0.30
Eastern Indonesia x Year-after-policy					0.92	0.86	0.99	0.02
Random Parameters	Est.	s.e.	95% CI		s.e.	95% CI	Est.	
Level-2: Between-province variation	0.30	0.08	0.18	0.49	0.30	0.08	0.19	0.50

Manuscript 3 Appendix 12. Logistic regression for Models A-B testing different interaction terms for the association between JKN and institutional delivery

Variable	Institutional Delivery							
	Model B				Model C			
	Adjusted OR (95%CI)	95% CI		P-value	Adjusted OR (95%CI)	95% CI		P-value
Time (year quarterly)	1.03	1.03	1.03	0.00	1.03	1.03	1.03	0.00
JKN policy	1.65	1.24	2.19	0.00	1.31	0.85	2.03	0.23
Time after policy (quarter)	1.02	0.99	1.04	0.25	1.06	1.01	1.10	0.02
Asset quintiles (Poorest as reference)								
Poor	1.70	1.55	1.86	0.00	1.69	1.56	1.82	0.00
Middle	2.32	2.11	2.55	0.00	2.25	2.07	2.45	0.00
Rich	3.64	3.28	4.03	0.00	3.36	3.06	3.69	0.00
Richest	6.58	5.80	7.45	0.00	6.25	5.56	7.03	0.00
Age at delivery (15-25 as reference)								
26-35 years	1.45	1.36	1.55	0.00	1.45	1.36	1.55	0.00
36 – 42 years	1.99	1.80	2.21	0.00	1.99	1.79	2.20	0.00
42 – 49 years	2.12	1.66	2.70	0.00	2.11	1.65	2.69	0.00
Marital status (not-married as reference)								
Married	1.06	0.92	1.23	0.42	1.03	0.89	1.19	0.73
Parity (1 child as reference)								
2 or more children	1.71	1.59	1.83	0.00	1.70	1.59	1.82	0.00
Education (none as reference)								
Primary	1.81	1.50	2.19	0.00	1.81	1.50	2.18	0.00
Secondary	3.30	2.73	3.99	0.00	3.30	2.74	3.99	0.00
Post-secondary	4.93	3.95	6.16	0.00	4.89	3.92	6.10	0.00
Women's occupation (none as reference)								
Agriculture	0.69	0.63	0.75	0.00	0.68	0.62	0.74	0.00
Blue-collar	1.06	0.99	1.13	0.11	1.05	0.98	1.12	0.16
White-collar	1.00	0.88	1.13	0.99	0.99	0.88	1.13	0.92
Residency (rural as reference)								
Urban	2.83	2.66	3.01	0.00	2.83	2.66	3.01	0.00
Region of residency (Java-Bali as reference)								
Sumatera	0.38	0.17	0.84	0.02	0.40	0.18	0.89	0.03
Kalimantan	0.20	0.08	0.53	0.00	0.23	0.09	0.60	0.00
Sulawesi	0.23	0.09	0.57	0.00	0.21	0.08	0.52	0.00
Eastern Indonesia	0.22	0.09	0.54	0.00	0.24	0.10	0.60	0.00
Season dummy								
January - March	0.98	0.91	1.06	0.65	0.98	0.91	1.06	0.63
April - June	1.00	0.93	1.08	0.97	1.00	0.93	1.08	0.99
July - September	1.01	0.94	1.09	0.71	1.02	0.94	1.10	0.69
October – December								
Wealth x Policy Process interaction								
Quintile 2 x Policy Process	1.01	0.64	1.59	0.96				
Quintile 3 x Policy Process	0.68	0.41	1.13	0.13				
Quintile 4 x Policy Process	0.87	0.48	1.56	0.63				
Quintile 5 x Policy Process	0.38	0.17	0.86	0.02				
Wealth x Year-after-policy interaction								
Quintile 2 x Year-after-policy	1.00	0.96	1.05	0.96				
Quintile 3 x Year-after-policy	1.03	0.98	1.09	0.23				
Quintile 4 x Year-after-policy	0.97	0.92	1.03	0.28				
Quintile 5 x Year-after-policy	1.07	0.98	1.16	0.13				
Region x Policy Process interaction								
Sumatera x Policy Process					0.69	0.40	1.19	0.18
Kalimantan x Policy Process					0.81	0.41	1.61	0.54
Sulawesi x Policy Process					2.06	1.12	3.78	0.02
Eastern Indonesia x Policy Process					1.39	0.79	2.46	0.26
Region x Year-after-policy interaction								
Sumatera x Year-after-policy					1.00	0.94	1.06	0.97
Kalimantan x Year-after-policy					0.97	0.90	1.04	0.36
Sulawesi x Year-after-policy					0.96	0.90	1.02	0.20
Eastern Indonesia x Year-after-policy					0.92	0.87	0.98	0.01
Random Parameters	Est.	s.e.	95% CI		s.e.	95% CI	Est.	
Level-2: Between-province variation	0.68	0.17	0.42	1.10	0.69	0.17	0.43	1.12

Manuscript 3 Appendix 13. Logistic regression for Models A-B testing different interaction terms for the association between JKN and caesarean section

Variable	Caesarean Section							
	Model B				Model C			
	Adjusted OR (95%CI)	95% CI		P-value	Adjusted OR (95%CI)	95% CI		P-value
Time (year quarterly)	1.03	1.03	1.03	0.00	1.03	1.03	1.03	0.00
JKN policy	0.94	0.55	1.60	0.81	0.87	0.63	1.20	0.40
Time after policy (quarter)	0.98	0.94	1.03	0.54	0.98	0.96	1.01	0.30
Asset quintiles (Poorest as reference)								
Poor	1.72	1.43	2.06	0.00	1.72	1.49	1.98	0.00
Middle	1.99	1.66	2.39	0.00	1.97	1.71	2.28	0.00
Rich	2.85	2.38	3.41	0.00	2.69	2.32	3.11	0.00
Richest	3.91	3.25	4.70	0.00	3.64	3.13	4.25	0.00
Age at delivery (15-25 as reference)								
26-35 years	1.52	1.39	1.65	0.00	1.53	1.40	1.66	0.00
36 – 42 years	2.75	2.42	3.12	0.00	2.77	2.44	3.14	0.00
42 – 49 years	2.92	2.16	3.95	0.00	2.93	2.17	3.96	0.00
Marital status (not-married as reference)								
Married	1.02	0.82	1.28	0.84	1.01	0.80	1.26	0.95
Parity (1 child as reference)								
2 or more children	1.67	1.53	1.83	0.00	1.68	1.53	1.83	0.00
Education (none as reference)								
Primary	1.75	1.12	2.74	0.01	1.79	1.14	2.80	0.01
Secondary	2.43	1.55	3.79	0.00	2.50	1.60	3.90	0.00
Post-secondary	3.96	2.51	6.26	0.00	4.06	2.57	6.41	0.00
Women's occupation (none as reference)								
Agriculture	0.68	0.57	0.81	0.00	0.67	0.56	0.80	0.00
Blue-collar	0.97	0.89	1.05	0.42	0.96	0.89	1.05	0.40
White-collar	1.10	0.98	1.23	0.12	1.10	0.98	1.23	0.12
Residency (rural as reference)								
Urban	1.42	1.31	1.54	0.00	1.42	1.31	1.55	0.00
Region of residency (Java-Bali as reference)								
Sumatera	1.14	0.91	1.44	0.25	1.10	0.86	1.40	0.46
Kalimantan	0.82	0.61	1.10	0.18	0.88	0.64	1.20	0.42
Sulawesi	0.89	0.68	1.16	0.39	0.80	0.60	1.07	0.14
Eastern Indonesia	0.81	0.62	1.07	0.14	0.90	0.67	1.21	0.50
Season dummy								
January - March	1.02	0.92	1.12	0.71	1.02	0.92	1.12	0.70
April - June	0.91	0.83	1.00	0.06	0.91	0.83	1.00	0.06
July - September	1.00	0.91	1.10	0.99	1.00	0.90	1.10	0.98
October - December								
Wealth x Policy Process interaction								
Quintile 2 x Policy Process	1.07	0.54	2.11	0.85				
Quintile 3 x Policy Process	0.85	0.43	1.67	0.64				
Quintile 4 x Policy Process	1.15	0.60	2.22	0.67				
Quintile 5 x Policy Process	0.88	0.46	1.66	0.69				
Wealth x Year-after-policy interaction								
Quintile 2 x Year-after-policy	1.00	0.93	1.06	0.89				
Quintile 3 x Year-after-policy	1.02	0.96	1.08	0.58				
Quintile 4 x Year-after-policy	0.97	0.92	1.04	0.40				
Quintile 5 x Year-after-policy	1.00	0.94	1.06	0.96				
Region x Policy Process interaction								
Sumatera x Policy Process					1.16	0.74	1.82	0.52
Kalimantan x Policy Process					1.39	0.70	2.77	0.35
Sulawesi x Policy Process					1.06	0.58	1.91	0.85
Eastern Indonesia x Policy Process					0.78	0.41	1.47	0.44
Region x Year-after-policy interaction								
Sumatera x Year-after-policy					1.00	0.95	1.04	0.84
Kalimantan x Year-after-policy					0.95	0.89	1.01	0.12
Sulawesi x Year-after-policy					1.02	0.96	1.08	0.49
Eastern Indonesia x Year-after-policy					1.00	0.94	1.06	0.97
Random Parameters	Est.	s.e.	95% CI		s.e.	95% CI	Est.	
Level-2: Between-province variation	0.05	0.01	0.03	0.09	0.05	0.01	0.03	0.09

Manuscript 3 Appendix 14. Logistic regression for Models A-B testing different interaction terms for the association between JKN and neonatal mortality

Variable	Neonatal Mortality							
	Model B				Model C			
	Adjusted OR (95%CI)	95% CI		P-value	Adjusted OR (95%CI)	95% CI		P-value
Time (year)	1.00	0.99	1.01	0.47	1.00	0.99	1.01	0.46
Policy process	0.78	0.30	1.98	0.60	1.12	0.35	3.57	0.85
Time after policy (year)	1.03	0.75	1.42	0.86	0.85	0.56	1.29	0.46
Asset quintiles (Poorest as reference)								
Poor	0.85	0.76	0.94	0.00	0.84	0.76	0.93	0.00
Middle	0.86	0.77	0.97	0.02	0.87	0.77	0.97	0.02
Rich	0.75	0.66	0.86	0.00	0.78	0.68	0.89	0.00
Richest	0.63	0.53	0.74	0.00	0.63	0.54	0.74	0.00
Age at delivery (15-25 as reference)								
26-35 years	0.60	0.56	0.66	0.00	0.60	0.56	0.66	0.00
36 – 42 years	0.71	0.63	0.81	0.00	0.71	0.63	0.81	0.00
42 – 49 years	1.18	0.85	1.65	0.32	1.18	0.85	1.65	0.32
Marital status (not-married as reference)								
Married	0.82	0.70	0.96	0.02	0.83	0.71	0.97	0.02
Parity (1 child as reference)								
2 or more children	0.40	0.36	0.43	0.00	0.40	0.36	0.43	0.00
Education (none as reference)								
Primary	0.88	0.74	1.04	0.13	0.88	0.74	1.04	0.13
Secondary	0.80	0.67	0.95	0.01	0.79	0.67	0.95	0.01
Post-secondary	0.74	0.58	0.95	0.02	0.75	0.58	0.95	0.02
Women's occupation (none as reference)								
Agriculture	1.03	0.93	1.15	0.52	1.04	0.94	1.15	0.48
Blue-collar	1.03	0.94	1.12	0.50	1.03	0.95	1.13	0.49
White-collar	1.18	0.98	1.41	0.07	1.18	0.99	1.41	0.07
Residency (rural as reference)								
Urban	1.02	0.93	1.11	0.73	1.02	0.93	1.11	0.73
Region of residency (Java-Bali as reference)								
Sumatera	1.00	0.83	1.21	0.98	0.99	0.82	1.19	0.90
Kalimantan	0.99	0.79	1.25	0.95	0.96	0.76	1.22	0.75
Sulawesi	1.04	0.84	1.29	0.71	1.03	0.83	1.27	0.82
Eastern Indonesia	1.00	0.81	1.23	0.98	0.99	0.79	1.22	0.89
Season dummy								
January - March	1.15	1.03	1.27	0.01	1.15	1.03	1.27	0.01
April - June	1.10	0.99	1.22	0.06	1.10	0.99	1.22	0.06
July - September	1.07	0.97	1.19	0.18	1.07	0.97	1.19	0.18
October - December								
Wealth x Policy Process interaction								
Quintile 2 x Policy Process	1.59	0.32	7.90	0.57				
Quintile 3 x Policy Process	1.50	0.32	7.12	0.61				
Quintile 4 x Policy Process	1.57	0.35	7.13	0.56				
Quintile 5 x Policy Process	0.93	0.15	6.01	0.94				
Wealth x Year-after-policy interaction								
Quintile 2 x Year-after-policy	0.78	0.44	1.39	0.40				
Quintile 3 x Year-after-policy	0.88	0.51	1.52	0.66				
Quintile 4 x Year-after-policy	1.03	0.61	1.72	0.92				
Quintile 5 x Year-after-policy	1.09	0.58	2.04	0.80				
Region x Policy Process interaction								
Sumatera x Policy Process					0.38	0.08	1.88	0.23
Kalimantan x Policy Process					5.89	1.01	34.26	0.05
Sulawesi x Policy Process					1.66	0.31	8.81	0.55
Eastern Indonesia x Policy Process					0.34	0.06	1.88	0.22
Region x Year-after-policy interaction								
Sumatera x Year-after-policy					1.57	0.90	2.71	0.11
Kalimantan x Year-after-policy					0.61	0.31	1.21	0.16
Sulawesi x Year-after-policy					0.93	0.51	1.69	0.80
Eastern Indonesia x Year-after-policy					1.58	0.88	2.81	0.12
Random Parameters	Est.	s.e.	95% CI		s.e.	95% CI	Est.	
Level-2: Between-province variation	0.02	0.01	0.01	0.05	0.02	0.01	0.01	0.05

Manuscript 3 Appendix 15. Logistic regression for Models A-B testing different interactions terms for the association between JKN and infant mortality

Variable	Infant Mortality							
	Model B				Model C			
	Adjusted OR (95%CI)	95% CI		P-value	Adjusted OR (95%CI)	95% CI		P-value
Time (year)	0.98	0.97	0.99	0.00	0.98	0.97	0.99	0.00
Policy process	0.80	0.38	1.67	0.55	1.14	0.44	2.94	0.79
Time after policy (year)	1.01	0.78	1.31	0.94	0.89	0.64	1.25	0.52
Asset quintiles (Poorest as reference)								
Poor	0.78	0.72	0.84	0.00	0.78	0.72	0.84	0.00
Middle	0.74	0.67	0.81	0.00	0.74	0.67	0.81	0.00
Rich	0.64	0.57	0.71	0.00	0.66	0.59	0.73	0.00
Richest	0.52	0.45	0.59	0.00	0.53	0.47	0.60	0.00
Age at delivery (15-25 as reference)								
26-35 years	0.65	0.61	0.69	0.00	0.65	0.61	0.69	0.00
36 – 42 years	0.74	0.67	0.81	0.00	0.74	0.67	0.81	0.00
42 – 49 years	1.04	0.79	1.37	0.78	1.04	0.79	1.37	0.77
Marital status (not-married as reference)								
Married	0.80	0.71	0.89	0.00	0.80	0.71	0.90	0.00
Parity (1 child as reference)								
2 or more children	0.38	0.36	0.41	0.00	0.38	0.36	0.41	0.00
Education (none as reference)								
Primary	0.81	0.72	0.91	0.00	0.80	0.71	0.91	0.00
Secondary	0.68	0.60	0.77	0.00	0.68	0.60	0.77	0.00
Post-secondary	0.63	0.52	0.76	0.00	0.63	0.53	0.77	0.00
Women's occupation (none as reference)								
Agriculture	1.09	1.01	1.18	0.02	1.10	1.02	1.19	0.02
Blue-collar	1.03	0.96	1.10	0.45	1.03	0.96	1.10	0.43
White-collar	1.18	1.02	1.36	0.03	1.18	1.02	1.36	0.03
Residency (rural as reference)								
Urban	0.98	0.92	1.05	0.62	0.98	0.92	1.05	0.62
Region of residency (Java-Bali as reference)								
Sumatera	0.94	0.80	1.11	0.46	0.93	0.79	1.10	0.42
Kalimantan	0.93	0.76	1.14	0.48	0.91	0.74	1.12	0.37
Sulawesi	1.13	0.94	1.35	0.20	1.12	0.93	1.34	0.24
Eastern Indonesia	1.09	0.91	1.31	0.33	1.09	0.91	1.31	0.37
Season dummy								
January - March	1.14	1.05	1.24	0.00	1.14	1.05	1.24	0.00
April - June	1.12	1.03	1.21	0.01	1.12	1.03	1.21	0.01
July - September	1.14	1.05	1.23	0.00	1.14	1.05	1.23	0.00
October - December								
Wealth x Policy Process interaction								
Quintile 2 x Policy Process	1.77	0.51	6.20	0.37				
Quintile 3 x Policy Process	1.51	0.40	5.71	0.54				
Quintile 4 x Policy Process	1.68	0.46	6.06	0.43				
Quintile 5 x Policy Process	1.35	0.32	5.73	0.68				
Wealth x Year-after-policy interaction								
Quintile 2 x Year-after-policy	0.81	0.52	1.27	0.37				
Quintile 3 x Year-after-policy	0.89	0.55	1.41	0.61				
Quintile 4 x Year-after-policy	1.02	0.65	1.58	0.95				
Quintile 5 x Year-after-policy	1.08	0.66	1.77	0.76				
Region x Policy Process interaction								
Sumatera x Policy Process					0.50	0.13	1.89	0.31
Kalimantan x Policy Process					3.53	0.77	16.16	0.10
Sulawesi x Policy Process					1.43	0.37	5.53	0.60
Eastern Indonesia x Policy Process					0.56	0.15	2.12	0.39
Region x Year-after-policy interaction								
Sumatera x Year-after-policy					1.35	0.86	2.14	0.20
Kalimantan x Year-after-policy					0.72	0.41	1.29	0.27
Sulawesi x Year-after-policy					0.95	0.59	1.54	0.85
Eastern Indonesia x Year-after-policy					1.26	0.80	2.01	0.32
Random Parameters	Est.	s.e.	95% CI		s.e.	95% CI	Est.	
Level-2: Between-province variation	0.02	0.01	0.01	0.04	0.02	0.01	0.01	0.04

Manuscript 3 Appendix 16. Sensitivity analysis for maternal health services use outcomes: 'false' intervention initiation timing (policy in 2011 instead of 2014)

Variable	ANC 4+				Skilled birth attendance				Institutional delivery				Caesarean section			
	Adjusted OR	95% CI		p-value	Adjusted OR	95% CI		p-value	Adjusted OR	95% CI		p-value	Adjusted OR	95% CI		p-value
Time (year quarterly)	1.01	1.00	1.01	0.00	1.02	1.01	1.02	0.00	1.03	1.02	1.03	0.00	1.03	1.03	1.04	0.00
Policy in 2011	0.98	0.87	1.10	0.70	1.03	0.91	1.16	0.67	1.10	0.99	1.22	0.07	0.91	0.80	1.04	0.16
Time after policy (quarter)	1.01	1.01	1.02	0.00	1.03	1.02	1.04	0.00	1.03	1.03	1.04	0.00	0.99	0.98	0.99	0.00
<i>Asset quintiles (Poorest as reference)</i>																
Poor	1.60	1.48	1.73	0.00	1.90	1.77	2.05	0.00	1.69	1.57	1.83	0.00	1.73	1.50	1.99	0.00
Middle	2.02	1.84	2.21	0.00	3.02	2.75	3.32	0.00	2.26	2.08	2.46	0.00	1.98	1.72	2.29	0.00
Rich	3.00	2.67	3.37	0.00	5.31	4.69	6.02	0.00	3.36	3.06	3.69	0.00	2.71	2.34	3.13	0.00
Richest	5.33	4.51	6.28	0.00	11.75	9.66	14.29	0.00	6.21	5.53	6.98	0.00	3.67	3.15	4.28	0.00
<i>Age at delivery (15-25 as reference)</i>																
26-35 years	1.50	1.39	1.61	0.00	1.54	1.43	1.66	0.00	1.45	1.36	1.55	0.00	1.52	1.40	1.66	0.00
36 – 42 years	1.35	1.21	1.50	0.00	1.80	1.61	2.02	0.00	2.00	1.80	2.22	0.00	2.76	2.43	3.13	0.00
42 – 49 years	1.29	1.02	1.63	0.03	1.79	1.40	2.30	0.00	2.14	1.67	2.72	0.00	2.92	2.16	3.94	0.00
<i>Marital status (not-married as reference)</i>																
Married	1.90	1.65	2.19	0.00	1.24	1.06	1.44	0.01	1.06	0.91	1.23	0.46	1.02	0.82	1.28	0.85
<i>Parity (1 child as reference)</i>																
2 or more children	1.71	1.59	1.85	0.00	1.80	1.67	1.94	0.00	1.71	1.60	1.83	0.00	1.68	1.53	1.83	0.00
<i>Education (none as reference)</i>																
Primary	2.24	1.96	2.57	0.00	2.18	1.89	2.52	0.00	1.83	1.52	2.21	0.00	1.76	1.13	2.76	0.01
Secondary	3.86	3.36	4.44	0.00	4.81	4.13	5.59	0.00	3.34	2.77	4.04	0.00	2.45	1.57	3.83	0.00
Post-secondary	4.67	3.77	5.78	0.00	9.50	7.30	12.37	0.00	4.93	3.95	6.15	0.00	4.00	2.53	6.31	0.00
<i>Women's occupation (none as reference)</i>																
Agriculture	0.84	0.78	0.91	0.00	0.68	0.63	0.73	0.00	0.69	0.63	0.75	0.00	0.67	0.57	0.80	0.00
Blue-collar	1.18	1.09	1.28	0.00	1.09	1.01	1.18	0.04	1.06	0.99	1.14	0.08	0.96	0.89	1.05	0.38
White-collar	1.36	1.13	1.63	0.00	1.37	1.10	1.70	0.01	1.00	0.88	1.13	0.98	1.10	0.98	1.23	0.12
<i>Residency (rural as reference)</i>																
Urban	1.16	1.08	1.25	0.00	1.73	1.60	1.87	0.00	2.83	2.66	3.01	0.00	1.42	1.31	1.55	0.00
<i>Region of residency (Java-Bali as reference)</i>																
Sumatera	0.53	0.35	0.81	0.00	1.31	0.77	2.25	0.32	0.38	0.17	0.84	0.02	1.14	0.90	1.43	0.27
Kalimantan	0.59	0.36	0.97	0.04	0.78	0.41	1.49	0.45	0.20	0.08	0.52	0.00	0.82	0.61	1.09	0.17
Sulawesi	0.41	0.26	0.65	0.00	0.65	0.36	1.20	0.17	0.23	0.09	0.57	0.00	0.89	0.68	1.16	0.37
Eastern Indonesia	0.43	0.27	0.68	0.00	0.39	0.21	0.71	0.00	0.22	0.09	0.54	0.00	0.81	0.62	1.07	0.14
<i>Months (dummy)</i>																
January - March	0.97	0.90	1.06	0.50	1.02	0.94	1.12	0.57	0.97	0.90	1.05	0.43	1.03	0.93	1.14	0.56
April - June	0.97	0.89	1.05	0.41	1.01	0.93	1.10	0.76	0.99	0.92	1.06	0.72	0.92	0.83	1.01	0.08
July - September	1.03	0.95	1.12	0.50	1.01	0.93	1.10	0.79	1.02	0.94	1.10	0.69	0.99	0.90	1.10	0.91
October - December	(omitted)				(omitted)				(omitted)				(omitted)			
<i>Random Parameters</i>	Est.	s.e.	95% CI		Est.	s.e.	95% CI		Est.	s.e.	95% CI		Est.	s.e.	95% CI	
Level-2: Between-province variation	0.17	0.04	0.10	0.29	0.30	0.08	0.18	0.49	0.68	0.17	0.42	1.10	0.05	0.01	0.03	0.09

Manuscript 3 Appendix 17. Sensitivity analysis for child mortality outcomes: different policy earlier year intervention (policy in 2011 instead of 2014)

Variable	Neonatal mortality				Infant mortality			
	Adjusted OR (95%CI)	95% CI		p-value	Adjusted OR (95%CI)	95% CI		p-value
Time	0.99	0.98	1.01	0.43	0.98	0.97	0.99	0.00
Policy in 2011	1.08	0.92	1.27	0.37	1.13	0.99	1.28	0.07
Time after policy (year)	0.97	0.92	1.01	0.17	0.97	0.93	1.01	0.14
Asset quintiles (Poorest as reference)								
Poor	0.84	0.76	0.93	0.00	0.78	0.72	0.84	0.00
Middle	0.87	0.77	0.98	0.02	0.74	0.67	0.81	0.00
Rich	0.78	0.68	0.89	0.00	0.66	0.59	0.73	0.00
Richest	0.63	0.54	0.74	0.00	0.53	0.47	0.60	0.00
Age at delivery (15-25 as reference)								
26-35 years	0.60	0.56	0.66	0.00	0.65	0.61	0.69	0.00
36 – 42 years	0.71	0.63	0.81	0.00	0.74	0.67	0.81	0.00
42 – 49 years	1.18	0.84	1.64	0.34	1.04	0.79	1.36	0.80
Marital status (not-married as reference)								
Married	0.83	0.71	0.97	0.02	0.80	0.71	0.90	0.00
Parity (1 child as reference)								
2 or more children	0.40	0.36	0.43	0.00	0.38	0.36	0.41	0.00
Education (none as reference)								
Primary	0.88	0.74	1.04	0.12	0.80	0.71	0.91	0.00
Secondary	0.79	0.67	0.94	0.01	0.68	0.60	0.77	0.00
Post-secondary	0.74	0.58	0.95	0.02	0.63	0.52	0.77	0.00
Women's occupation (none as reference)								
Agriculture	1.04	0.94	1.15	0.48	1.10	1.02	1.19	0.02
Blue-collar	1.03	0.95	1.13	0.48	1.03	0.96	1.10	0.42
White-collar	1.18	0.99	1.41	0.07	1.18	1.02	1.36	0.03
Residency (rural as reference)								
Urban	1.02	0.93	1.11	0.74	0.98	0.92	1.05	0.61
Region of residency (Java-Bali as reference)								
Sumatera	1.00	0.83	1.21	0.99	0.94	0.80	1.11	0.46
Kalimantan	0.99	0.79	1.25	0.95	0.93	0.76	1.14	0.49
Sulawesi	1.04	0.84	1.29	0.71	1.13	0.94	1.36	0.20
Eastern Indonesia	1.00	0.81	1.23	0.97	1.09	0.91	1.31	0.34
Season dummy								
January - March	1.15	1.03	1.27	0.01	1.14	1.05	1.24	0.00
April - June	1.10	1.00	1.22	0.06	1.12	1.03	1.21	0.01
July - September	1.08	0.97	1.19	0.18	1.14	1.05	1.23	0.00
October - December	(omitted)				(omitted)			
Random Parameters								
	Est.	s.e.	95% CI		Est.	s.e.	95% CI	
Level-2: Between-province variation	0.02	0.01	0.01	0.05	0.02	0.01	0.01	0.04

Manuscript 3 Appendix 18. Sensitivity analysis for maternal health services use outcomes: before and after JKN effect

Variable	ANC 4+				Skilled birth attendance				Institutional delivery				Caesarean section			
	Adjusted OR	95% CI		p-value	Adjusted OR	95% CI		p-value	Adjusted OR	95% CI		p-value	Adjusted OR	95% CI		p-value
Time (year quarterly)	1.01	1.00	1.01	0.00	1.02	1.02	1.02	0.00	1.03	1.03	1.03	0.00	1.03	1.03	1.03	0.00
JKN policy	1.36	1.21	1.52	0.00	1.80	1.60	2.03	0.00	1.75	1.59	1.94	0.00	0.77	0.68	0.87	0.00
<i>Asset quintiles (Poorest as reference)</i>																
Poor	1.60	1.48	1.73	0.00	1.90	1.76	2.05	0.00	1.69	1.56	1.83	0.00	1.73	1.51	2.00	0.00
Middle	2.02	1.84	2.22	0.00	3.01	2.74	3.32	0.00	2.25	2.06	2.44	0.00	1.99	1.72	2.30	0.00
Rich	3.01	2.68	3.38	0.00	5.31	4.68	6.02	0.00	3.35	3.05	3.68	0.00	2.71	2.34	3.13	0.00
Richest	5.33	4.51	6.28	0.00	11.74	9.65	14.28	0.00	6.20	5.52	6.97	0.00	3.68	3.15	4.28	0.00
<i>Age at delivery (15-25 as reference)</i>																
26-35 years	1.50	1.39	1.61	0.00	1.54	1.43	1.66	0.00	1.45	1.36	1.55	0.00	1.52	1.40	1.66	0.00
36 – 42 years	1.35	1.21	1.50	0.00	1.80	1.61	2.02	0.00	2.00	1.80	2.21	0.00	2.76	2.44	3.13	0.00
42 – 49 years	1.28	1.02	1.62	0.04	1.78	1.39	2.29	0.00	2.12	1.66	2.70	0.00	2.93	2.17	3.97	0.00
<i>Marital status (not-married as reference)</i>																
Married	1.90	1.65	2.19	0.00	1.23	1.06	1.43	0.01	1.06	0.91	1.22	0.47	1.02	0.81	1.28	0.87
<i>Parity (1 child as reference)</i>																
2 or more children	1.71	1.59	1.85	0.00	1.80	1.67	1.94	0.00	1.71	1.59	1.83	0.00	1.68	1.53	1.84	0.00
<i>Education (none as reference)</i>																
Primary	2.24	1.96	2.56	0.00	2.17	1.88	2.51	0.00	1.82	1.51	2.19	0.00	1.77	1.13	2.77	0.01
Secondary	3.86	3.35	4.43	0.00	4.78	4.11	5.56	0.00	3.31	2.74	4.00	0.00	2.47	1.58	3.86	0.00
Post-secondary	4.65	3.75	5.75	0.00	9.47	7.28	12.33	0.00	4.90	3.93	6.11	0.00	4.02	2.54	6.34	0.00
<i>Women's occupation (none as reference)</i>																
Agriculture	0.84	0.78	0.91	0.00	0.67	0.62	0.73	0.00	0.68	0.62	0.74	0.00	0.68	0.57	0.81	0.00
Blue-collar	1.18	1.09	1.28	0.00	1.08	1.00	1.17	0.06	1.05	0.98	1.12	0.15	0.97	0.89	1.05	0.46
White-collar	1.36	1.13	1.63	0.00	1.37	1.10	1.70	0.01	0.99	0.88	1.13	0.93	1.10	0.98	1.23	0.11
<i>Residency (rural as reference)</i>																
Urban	1.16	1.08	1.25	0.00	1.74	1.61	1.88	0.00	2.83	2.66	3.01	0.00	1.43	1.31	1.55	0.00
<i>Region of residency (Java-Bali as reference)</i>																
Sumatera	0.53	0.35	0.81	0.00	1.31	0.76	2.25	0.33	0.38	0.17	0.83	0.02	1.14	0.91	1.43	0.27
Kalimantan	0.59	0.36	0.97	0.04	0.78	0.41	1.48	0.44	0.20	0.08	0.52	0.00	0.82	0.61	1.09	0.17
Sulawesi	0.41	0.26	0.65	0.00	0.65	0.35	1.20	0.17	0.23	0.09	0.57	0.00	0.89	0.68	1.16	0.38
Eastern Indonesia	0.43	0.27	0.68	0.00	0.39	0.21	0.71	0.00	0.22	0.09	0.54	0.00	0.81	0.62	1.07	0.14
<i>Months (dummy)</i>																
January - March	0.97	0.90	1.06	0.51	1.03	0.95	1.12	0.46	0.98	0.91	1.06	0.68	1.02	0.92	1.12	0.74
April - June	0.97	0.90	1.05	0.47	1.03	0.94	1.11	0.55	1.01	0.94	1.08	0.86	0.90	0.82	1.00	0.04
July - September	1.03	0.95	1.12	0.47	1.02	0.93	1.10	0.71	1.02	0.95	1.10	0.55	0.99	0.90	1.09	0.82
October - December	(omitted)				(omitted)				(omitted)				(omitted)			
<i>Random Parameters</i>																
	Est.	s.e.	95% CI		Est.	s.e.	95% CI		Est.	s.e.	95% CI		Est.	s.e.	95% CI	
Level-2: Between-province variation	0.17	0.04	0.10	0.29	0.30	0.08	0.18	0.49	0.68	0.17	0.42	1.09	0.05	0.01	0.03	0.09

Manuscript 3 Appendix 19. Sensitivity analysis for child mortality: before-and-after JKN effect

Variable	Neonatal mortality				Infant mortality			
	Adjusted OR (95%CI)	95% CI		p-value	Adjusted OR (95%CI)	95% CI		p-value
Time	1.00	0.99	1.01	0.46	0.98	0.97	0.99	0.00
Policy process	0.92	0.76	1.12	0.42	0.97	0.82	1.13	0.67
Asset quintiles (Poorest as reference)								
Poor	0.84	0.76	0.93	0.00	0.78	0.72	0.84	0.00
Middle	0.87	0.77	0.97	0.02	0.74	0.67	0.81	0.00
Rich	0.78	0.68	0.89	0.00	0.66	0.59	0.73	0.00
Richest	0.63	0.54	0.74	0.00	0.53	0.47	0.60	0.00
Age at delivery (15-25 as reference)								
26-35 years	0.60	0.56	0.66	0.00	0.65	0.61	0.69	0.00
36 – 42 years	0.71	0.63	0.81	0.00	0.74	0.67	0.81	0.00
42 – 49 years	1.18	0.84	1.64	0.34	1.04	0.79	1.37	0.79
Marital status (not-married as reference)								
Married	0.83	0.71	0.97	0.02	0.80	0.71	0.90	0.00
Parity (1 child as reference)								
2 or more children	0.40	0.36	0.43	0.00	0.38	0.36	0.41	0.00
Education (none as reference)								
Primary	0.88	0.74	1.04	0.12	0.80	0.71	0.91	0.00
Secondary	0.79	0.67	0.94	0.01	0.68	0.60	0.77	0.00
Post-secondary	0.75	0.58	0.95	0.02	0.63	0.52	0.77	0.00
Women's occupation (none as reference)								
Agriculture	1.04	0.94	1.15	0.48	1.10	1.02	1.19	0.02
Blue-collar	1.03	0.95	1.13	0.48	1.03	0.96	1.10	0.42
White-collar	1.18	0.99	1.41	0.07	1.18	1.02	1.36	0.03
Residency (rural as reference)								
Urban	1.02	0.93	1.11	0.74	0.98	0.92	1.05	0.62
Region of residency (Java-Bali as reference)								
Sumatera	1.00	0.83	1.21	0.99	0.94	0.80	1.11	0.46
Kalimantan	0.99	0.79	1.25	0.96	0.93	0.76	1.14	0.49
Sulawesi	1.04	0.84	1.29	0.71	1.13	0.94	1.36	0.20
Eastern Indonesia	1.00	0.81	1.23	0.97	1.09	0.91	1.31	0.34
Season dummy								
January - March	1.14	1.03	1.27	0.01	1.14	1.05	1.24	0.00
April - June	1.10	0.99	1.22	0.07	1.12	1.03	1.21	0.01
July - September	1.07	0.97	1.19	0.19	1.13	1.05	1.23	0.00
October - December	(omitted)				(omitted)			
Random Parameters	Est.	s.e.	95% CI		Est.	s.e.	95% CI	
Level-2: Between-province variation	0.02	0.01	0.01	0.05	0.02	0.01	0.01	0.04

Manuscript 3 Appendix 20. Sensitivity analysis for maternal health services use outcomes: shorter time period (2005-2017)

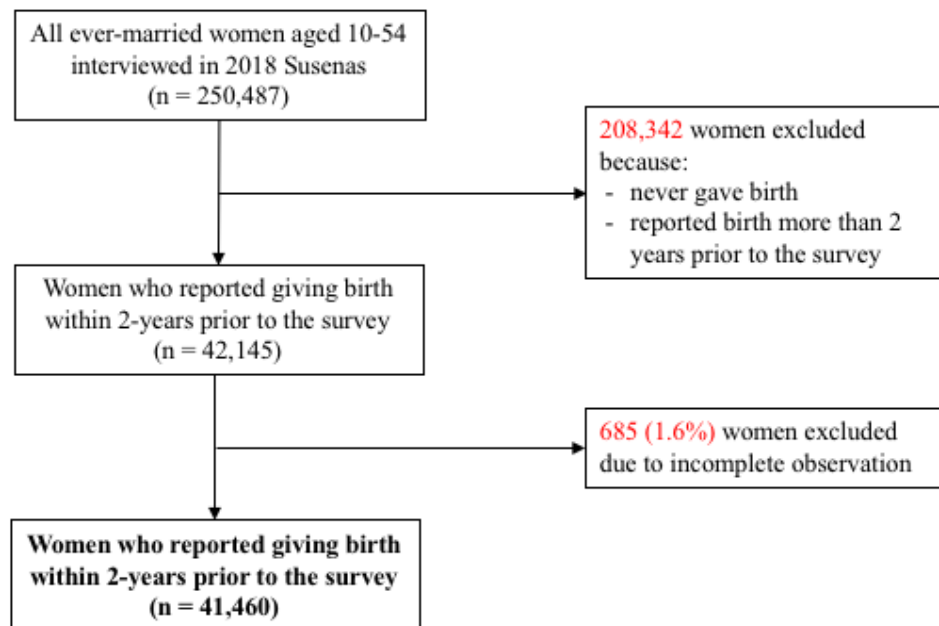
Variable	ANC 4+				Skilled birth attendance				Institutional delivery				Caesarean section			
	AOR	95% CI	p-value		AOR	95% CI	p-value		AOR	95% CI	p-value		AOR	95% CI	p-value	
Time (year quarterly)	1.01	1.01	1.02	0.00	1.03	1.02	1.03	0.00	1.04	1.04	1.04	0.00	1.03	1.02	1.03	0.00
JKN policy	1.56	1.23	1.98	0.00	1.58	1.22	2.06	0.00	1.18	0.97	1.43	0.11	0.95	0.77	1.17	0.61
Time after policy (quarter)	0.96	0.94	0.99	0.00	0.99	0.97	1.02	0.63	1.01	0.99	1.03	0.17	0.98	0.97	1.00	0.06
<i>Asset quintiles (Poorest as reference)</i>																
Poor	1.70	1.55	1.86	0.00	1.96	1.79	2.15	0.00	1.77	1.62	1.93	0.00	1.74	1.50	2.02	0.00
Middle	2.12	1.90	2.37	0.00	3.18	2.83	3.58	0.00	2.28	2.07	2.51	0.00	2.02	1.74	2.35	0.00
Rich	3.11	2.72	3.57	0.00	5.76	4.91	6.75	0.00	3.43	3.07	3.82	0.00	2.71	2.33	3.16	0.00
Richest	5.27	4.35	6.38	0.00	11.30	8.82	14.48	0.00	5.75	5.01	6.60	0.00	3.50	2.98	4.10	0.00
<i>Age at delivery (15-25 as reference)</i>																
26-35 years	1.56	1.43	1.70	0.00	1.61	1.47	1.77	0.00	1.45	1.34	1.56	0.00	1.54	1.41	1.69	0.00
36 – 42 years	1.43	1.26	1.62	0.00	1.99	1.73	2.28	0.00	2.08	1.85	2.34	0.00	2.72	2.38	3.11	0.00
42 – 49 years	1.44	1.10	1.89	0.01	1.78	1.33	2.37	0.00	2.23	1.70	2.92	0.00	2.83	2.07	3.88	0.00
<i>Marital status (not-married as reference)</i>																
Married	1.89	1.62	2.21	0.00	1.14	0.96	1.35	0.13	0.98	0.83	1.15	0.78	1.01	0.80	1.27	0.96
<i>Parity (1 child as reference)</i>																
2 or more children	1.75	1.60	1.91	0.00	1.77	1.61	1.95	0.00	1.74	1.61	1.88	0.00	1.65	1.50	1.82	0.00
<i>Education (none as reference)</i>																
Primary	2.18	1.84	2.59	0.00	2.42	2.01	2.91	0.00	1.76	1.40	2.20	0.00	1.79	1.09	2.94	0.02
Secondary	3.59	3.02	4.28	0.00	5.13	4.25	6.20	0.00	3.18	2.54	3.98	0.00	2.42	1.47	3.97	0.00
Post-secondary	4.06	3.18	5.19	0.00	9.10	6.74	12.30	0.00	4.50	3.47	5.83	0.00	3.72	2.24	6.18	0.00
<i>Women's occupation (none as reference)</i>																
Agriculture	0.83	0.76	0.92	0.00	0.65	0.59	0.72	0.00	0.69	0.62	0.76	0.00	0.68	0.57	0.82	0.00
Blue-collar	1.18	1.08	1.29	0.00	1.05	0.95	1.15	0.36	1.08	1.00	1.17	0.04	0.95	0.87	1.04	0.28
White-collar	1.31	1.08	1.60	0.01	1.34	1.05	1.72	0.02	0.98	0.85	1.13	0.75	1.17	1.03	1.32	0.01
<i>Residency (rural as reference)</i>																
Urban	1.14	1.05	1.24	0.00	1.74	1.58	1.91	0.00	2.75	2.56	2.95	0.00	1.43	1.31	1.55	0.00
<i>Region of residency (Java-Bali as reference)</i>																
Sumatera	0.50	0.32	0.79	0.00	0.95	0.51	1.79	0.88	0.30	0.13	0.69	0.01	1.21	0.97	1.51	0.09
Kalimantan	0.57	0.34	0.98	0.04	0.61	0.29	1.28	0.19	0.18	0.07	0.48	0.00	0.85	0.65	1.13	0.26
Sulawesi	0.40	0.24	0.67	0.00	0.47	0.23	0.95	0.04	0.20	0.08	0.51	0.00	0.96	0.74	1.24	0.75
Eastern Indonesia	0.43	0.26	0.70	0.00	0.30	0.15	0.61	0.00	0.19	0.07	0.48	0.00	0.84	0.65	1.09	0.19
<i>Months (dummy)</i>																
January - March	0.95	0.86	1.04	0.27	0.99	0.90	1.10	0.92	0.95	0.87	1.04	0.30	1.04	0.94	1.16	0.45
April - June	0.94	0.86	1.04	0.23	0.96	0.87	1.06	0.44	0.98	0.90	1.07	0.66	0.94	0.85	1.04	0.22
July - September	0.97	0.88	1.07	0.58	0.96	0.86	1.06	0.41	0.96	0.87	1.05	0.35	1.00	0.90	1.11	0.97
October - December	(omitted)				(omitted)				(omitted)				(omitted)			
<i>Random Parameters</i>	Est.	s.e.	95% CI		Est.	s.e.	95% CI		Est.	s.e.	95% CI		Est.	s.e.	95% CI	
Level-2: Between-province variation	0.19	0.05	0.12	0.32	0.39	0.10	0.24	0.65	0.72	0.18	0.44	1.17	0.04	0.01	0.02	0.08

Manuscript 3 Appendix 21. Sensitivity analysis for child mortality outcomes: shorter time period (2005-2017)

Variable	Neonatal mortality				Infant mortality			
	Adjusted OR (95%CI)	95% CI		p-value	Adjusted OR (95%CI)	95% CI		p-value
Time	1.00	0.98	1.02	0.94	0.99	0.97	1.01	0.25
Policy process	0.95	0.54	1.64	0.84	0.99	0.63	1.55	0.96
Time after policy (year)	0.99	0.82	1.19	0.89	0.96	0.83	1.13	0.65
Asset quintiles (Poorest as reference)								
Poor	0.85	0.73	0.99	0.04	0.75	0.67	0.84	0.00
Middle	0.85	0.72	1.00	0.06	0.71	0.62	0.82	0.00
Rich	0.79	0.65	0.95	0.01	0.70	0.60	0.81	0.00
Richest	0.63	0.51	0.79	0.00	0.56	0.47	0.67	0.00
Age at delivery (15-25 as reference)								
26-35 years	0.57	0.51	0.64	0.00	0.63	0.57	0.69	0.00
36 – 42 years	0.64	0.54	0.76	0.00	0.70	0.62	0.80	0.00
42 – 49 years	0.92	0.60	1.41	0.70	0.89	0.63	1.27	0.54
Marital status (not-married as reference)								
Married	0.97	0.76	1.22	0.77	0.92	0.77	1.10	0.37
Parity (1 child as reference)								
2 or more children	0.41	0.36	0.47	0.00	0.41	0.37	0.45	0.00
Education (none as reference)								
Primary	1.01	0.77	1.32	0.96	0.92	0.76	1.12	0.43
Secondary	0.94	0.71	1.25	0.68	0.80	0.65	0.98	0.03
Post-secondary	0.85	0.59	1.21	0.36	0.73	0.56	0.96	0.02
Women's occupation (none as reference)								
Agriculture	1.21	1.04	1.41	0.01	1.20	1.07	1.35	0.00
Blue-collar	1.11	0.98	1.25	0.09	1.11	1.00	1.22	0.04
White-collar	1.26	1.00	1.59	0.06	1.27	1.04	1.53	0.02
Residency (rural as reference)								
Urban	1.05	0.93	1.18	0.47	0.99	0.90	1.09	0.82
Region of residency (Java-Bali as reference)								
Sumatera	0.97	0.76	1.22	0.78	0.95	0.78	1.17	0.64
Kalimantan	0.98	0.73	1.31	0.88	0.98	0.77	1.26	0.89
Sulawesi	1.03	0.79	1.34	0.84	1.17	0.93	1.46	0.17
Eastern Indonesia	1.00	0.77	1.31	0.99	1.16	0.93	1.45	0.18
Season dummy								
January - March	1.12	0.97	1.30	0.12	1.14	1.01	1.28	0.03
April - June	1.15	0.99	1.32	0.07	1.13	1.01	1.27	0.04
July - September	1.12	0.96	1.30	0.14	1.09	0.97	1.23	0.14
October - December	(omitted)				(omitted)			
Random Parameters	Est.	s.e.	95% CI		Est.	s.e.	95% CI	
Level-2: Between-province variation	0.03	0.01	0.01	0.08	0.03	0.01	0.01	0.05

Appendix 4: Supplementary materials for Manuscript 4

Manuscript 4 Appendix 1. Sample flowchart



Manuscript 4 Appendix 2. Multinomial logit results for types of provider

Variable	OBGYN or GP		Midwife/nurse	
	vs TBA/other non-skilled		vs TBA/other non-skilled	
	Coef.	95% CI	Coef.	95% CI
Income quintile (ref: poorest)				
Poor	0.47***	(0.30, 0.63)	0.25***	(0.11, 0.39)
Middle	0.88***	(0.66, 1.09)	0.46***	(0.26, 0.66)
Rich	1.71***	(1.44, 1.99)	0.92***	(0.66, 1.19)
Richest	2.51***	(2.08, 2.94)	1.20***	(0.78, 1.63)
Insurance status (ref: no insurance)				
JKN	1.07***	(0.92, 1.21)	0.45***	(0.33, 0.58)
Private insurance	1.87***	(1.14, 2.60)	0.86**	(0.14, 1.58)
Residency (ref: rural)				
Urban	1.09***	(0.88, 1.30)	0.84***	(0.64, 1.05)
Region of residence (ref: Java-Bali)				
Sumatra	-0.30***	(-0.5, -0.11)	-0.11	(-0.30, 0.07)
Kalimantan	-1.04***	(-1.28, -0.80)	-0.58***	(-0.80, -0.36)
Sulawesi	-0.53***	(-0.76, -0.29)	-0.33***	(-0.55, -0.10)
Eastern Indonesia	-1.65***	(-1.85, -1.46)	-1.27***	(-1.45, -1.10)
Education (ref: no education)				
Primary	0.06	(-0.17, 0.28)	0.35***	(0.16, 0.54)
Secondary	1.26***	(1.02, 1.49)	1.21***	(1.01, 1.41)
Post-secondary	1.30***	(1.03, 1.57)	0.76***	(0.52, 1.00)
Women's work status (ref: not working)				
Working	-0.16**	(-0.30, -0.03)	-0.08	(-0.20, 0.04)
Maternal age (ref: <20 years)				
20-25 years	0.44***	(0.14, 0.74)	0.40***	(0.14, 0.66)
26-35 years	0.49***	(0.20, 0.78)	0.33***	(0.08, 0.58)
36+ years	0.90***	(0.59, 1.21)	0.41***	(0.14, 0.69)
Marital status (ref: not married)				
Married	0.38*	(-0.01, 0.77)	0.42***	(0.11, 0.73)

Note: Weighted for survey design; *significant at 10%; ** significant at 5%; ***significant at 1%.

Manuscript 4 Appendix 3. Multinomial logit results for place of delivery

Variable	Hospital vs home/others		Higher primary health facility vs home/others		Lower primary health facility vs home/others	
	Coef.	95% CI	Coef.	95% CI	Coef.	95% CI
Income quintile (ref: poorest)						
Poor	0.35***	(0.22, 0.48)	0.17***	(0.05, 0.28)	-0.08	(-0.21, 0.05)
Middle	0.61***	(0.46, 0.76)	0.31***	(0.17, 0.46)	-0.08	(-0.24, 0.08)
Rich	1.12***	(0.97, 1.27)	0.59***	(0.44, 0.74)	0.13	(-0.04, 0.30)
Richest	1.84***	(1.64, 2.05)	0.94***	(0.73, 1.15)	0.22*	(-0.03, 0.47)
Insurance status (ref: no insurance)						
JKN	1.20***	(1.09, 1.30)	0.54***	(0.45, 0.64)	0.29***	(0.18, 0.40)
Private insurance	1.56***	(1.27, 1.86)	0.60***	(0.30, 0.91)	0.38**	(0.03, 0.74)
Residency (ref: rural)						
Urban	1.09***	(0.97, 1.21)	1.08***	(0.96, 1.20)	0.56***	(0.42, 0.69)
Region of residence (ref: Java-Bali)						
Sumatra	-0.84***	(-0.97, -0.71)	-0.84***	(-0.96, -0.71)	-0.81***	(-0.95, -0.68)
Kalimantan	-1.11***	(-1.28, -0.95)	-1.16***	(-1.32, -1)	-1.39***	(-1.58, -1.20)
Sulawesi	-0.68***	(-0.83, -0.52)	-0.75***	(-0.90, -0.6)	-1.53***	(-1.70, -1.35)
Eastern Indonesia	-0.90***	(-1.05, -0.76)	-1.06***	(-1.20, -0.92)	-1.50***	(-1.68, -1.33)
Education (ref: no education)						
Primary	-0.24***	(-0.42, -0.07)	-0.06	(-0.23, 0.11)	0.15	(-0.05, 0.35)
Secondary	0.63***	(0.46, 0.80)	0.64***	(0.47, 0.80)	0.66***	(0.47, 0.85)
Post-secondary	1.00***	(0.80, 1.19)	0.64***	(0.44, 0.84)	0.35***	(0.11, 0.59)
Women's work status (ref: not working)						
Working	-0.17***	(-0.27, -0.07)	-0.15***	(-0.25, 0.06)	0.00	(-0.10, 0.11)
Maternal age (ref: <20 years)						
20-25 years	0.20*	(-0.01, 0.42)	0.33***	(0.13, 0.54)	0.10	(-0.12, 0.32)
26-35 years	0.31***	(0.10, 0.52)	0.33***	(0.14, 0.53)	0.10	(-0.11, 0.31)
36+ years	0.67***	(0.44, 0.89)	0.33***	(0.11, 0.54)	0.07	(-0.16, 0.30)
Marital status (ref: not married)						
Married	0.14	(-0.17, 0.45)	0.01	(-0.30, 0.32)	0.13	(-0.23, 0.48)

Note: Weighted for survey design; *significant at 10%; ** significant at 5%; ***significant at 1%.