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Author/s:
De Silva, MS;Panisi, L;Manubuasa, L;Honimae, C;Taragwanu, S;Burggraaf, S;Ogaoga, D;Lindquist, AC;Walker, SP;Tong, S;Hastie, R

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Incidence and causes of stillbirth in the only tertiary referral hospital in the Solomon Islands: a hospital-based retrospective cohort study

Manarangi Sajini De Silva ,[1] Leeanne Panisi,[2] Lenin Manubuasa,[2] Catherine Honimae,[2] Susan Taragwanu,[2] Simon Burggraaf,[3] Divinal Ogaoga,[4] Anthea Clare Lindquist,[5] Susan P Walker ,[5] Stephen Tong,[5] Roxanne Hastie[5]

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For numbered affiliations see end of article.

Correspondence to
Dr Manarangi Sajini De Silva; rangi.desilva7@gmail.com

ABSTRACT

Objectives Stillbirth is a major global health issue, which disproportionately affects families living in low-income and middle-income countries. The Solomon Islands is a Pacific nation with poor perinatal outcomes, however research investigating stillbirth is lacking. Thus, we aimed to investigate the incidence and cause of stillbirth occurring at the National Referral Hospital, Solomon Islands.

Design We conducted a retrospective cohort study from January 2017 to December 2018.

Setting At the only tertiary referral hospital in the Solomon Islands, on the main island of Guadalcanal.

Participants All births occurring in the hospital during the study period.

Outcome measures Number of, causes and risk factors for stillbirths (fetal deaths before birth at ≥20 estimated gestational weeks, or ≥500 g in birth weight).

Results Over 2 years 341 stillbirths and 11 056 total births were recorded, giving an institutional incidence of 31 stillbirths per 1000 births. Of the cases with a recorded cause of death, 72% were deemed preventable. Most stillbirths occurred antenatally and 62% at preterm gestations (<37 weeks). 59% had a birth weight below 2500 g and preventable maternal conditions were present in 42% of the cases. 46% of the cases were caused by an acute intrapartum event, and among these 92% did not receive intrapartum monitoring.

Conclusions Stillbirth affects 31 in every 1000 births at the National Referral Hospital in the Solomon Islands and many cases are preventable. Our findings highlight the urgent need for increased focus on perinatal deaths in the Solomon Islands with universal classification and targeted training, improved quality of obstetrical care and community awareness.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Ours is the first study investigating causes of stillbirths in the Solomon Islands.
⇒ We uncovered several areas of obstetrical care which could be improved to prevent stillbirth.
⇒ Our study was limited by a large amount of missing data and its retrospective design.
⇒ Cause of death was ascertained from case files without the support of verbal autopsy or postmortem examination as these investigations are currently not available in the Solomon Islands.

INTRODUCTION

Stillbirth is a significant global health issue, with an estimated 2.6 million women affected every year.[1–3] Approximately 98% of the stillbirths occur in low-income and middle-income countries (LMICs), with this burden most heavily felt in South-Asian and African countries.[2–5] Many stillbirths in LMICs are thought to be preventable. Despite this, little progress has been made in reducing these numbers compared with other perinatal outcomes.[3 4 6 7]

The Solomon Islands is a Pacific LMIC with a population of approximately 700 000, spanning across 993 islands. The country faces significant geographical, socioeconomic and cultural barriers to achieving health equity. The National Referral Hospital, on the main island of Guadalcanal, is the only tertiary hospital in the country. Despite this, there are limited midwifery staff and only four consultant obstetricians. Like many of its counterparts in the Asia-Pacific, the Solomon Islands has poor perinatal outcomes, with recent studies showing a high rate of preventable severe maternal morbidity,[8] maternal mortality[9] and an estimated stillbirth rate of 17.6 per 1000 births in 2015 from WHO data.[10] In contrast, the rate of stillbirth in Australia, one of the nation's closest neighbours, has a stillbirth rate of 6.8 per 1000 births.[11] Despite this, there has been little research into improving perinatal outcomes, and in particular, no previous targeted research investigating causes of stillbirth in the Solomon Islands.

To reduce the global burden of stillbirths, accurate recording of cause of death and preventable risk factors is required. This could help direct where to place scarce resources to have maximal impact in reducing rates of stillbirth. However, in many LMICs this is a significant challenge due to a lack of health worker training and diagnostic tools.[3 5 12 13] Furthermore, many countries do not have a national registration system for perinatal deaths, particularly in the Asia-Pacific region.[2 14] While there is also no national registry or classification of stillbirths in the Solomon Islands, they are audited at National Referral Hospital. This creates an opportunity to investigate the causes of stillbirth and identify those that may be preventable, as well as identifying gaps in information with the current data collection system. Such an investigation would assist in directing resources towards the most effective clinical service with the aim of ultimately reducing stillbirth in the Solomon Islands and other similar Pacific Island nations. Thus, we undertook a retrospective cohort study investigating the incidence of stillbirth, causes and associated risk factors in the Solomon Islands.

MATERIALS AND METHODS

We conducted a retrospective cohort study investigating all stillbirths recorded at the National Referral Hospital in Honiara, Solomon Islands, between January 2017 and December 2018. Informed consent was not needed, and patients and the public were not consulted as this was a retrospective study of de-identified case file data.

The National Referral Hospital is situated on the main island of Guadalcanal. It is supported by nine other regional hospitals throughout the country. The obstetrics and gynaecology department services 70% of the hospital's admissions and the annual delivery rate is 5000–6000 births per year, however there are only three beds in the delivery suite. The four consultant obstetricians and gynaecologists are supported by five to six specialists in training, very limited midwifery staff, anaesthetic staff and laboratory staff.

Stillbirth was defined as the death of a fetus before birth at ≥20 estimated gestational weeks, or >500 g in birth weight.[5 10 15] Antepartum stillbirth was defined as a death occurring before the onset of labour or 'macerated' in appearance. Intrapartum death was considered a death occurring after the onset of labour which had a 'fresh' appearance. Neonates were weighed at birth and fetal weight cut-offs of <2500 g and <1500 g were used to define low birth weight and extremely low birth weight, respectively, as gestational uncertainty decreased the accuracy of gestational centiles. The total numbers of live births and stillbirths during the study period were obtained from an existing hospital birth registry.

Available case files were reviewed for suspected cause of death and contributing maternal conditions. In the Solomon Islands verbal autopsy or detailed diagnostic tests are not available to confirm cause of death. Deaths were deemed preventable if they were over 28 weeks estimated gestation, above 1500 g birth weight and excluding those with congenital anomalies.

There are several international classification systems that aim to accurately determine the primary cause of stillbirths and risk factors that may inform public health and policy interventions.[13] In 2016 the WHO developed the 10th revision of the International Classification of Diseases (ICD-10) and applied to the perinatal period, perinatal mortality (ICD-PM).[13 16] The ICD-PM first identifies the timing of perinatal death (antepartum, intrapartum or unknown), then the assigns the main cause of death and links each stillbirth with the main maternal condition contributing to the stillbirth (online supplemental Appendix table S1). In this study, we used the ICD-PM to classify causes of stillbirth at the National Referral Hospital. Given there was no comparison group, descriptive statistics were used to describe the data. Statistical analyses were performed using Stata 15-IC. We used the Strengthening the Reporting of Observational Studies in Epidemiology cohort checklist to report our findings.[17]

RESULTS

Over 2 years, 341 stillbirths were documented at the National Referral Hospital. During the same period, there were 11 056 live births, giving an institutional incidence of stillbirth of 30.8 per 1000 births. Of 341 recorded cases, suspected cause of death was available for 198 (58%) and 142 (41%) maternal full case files were available for full review (table 1). Among the 142 case files available, 72% were considered preventable and there were 5 associated cases of maternal death.

Women who experienced a stillbirth had a median age of 28 years (IQR 11), 62% were multiparous and 9% grand-multiparous (≥5 prior births). The majority (79%) were married or cohabiting and 73% had at least a primary school-level of education. Most women were unemployed or homemakers (67%) and resided on the main island of Guadalcanal (60%). One-third (29%) of the mothers were referred to the National Referral Hospital for their care. Most stillbirths were delivered by midwifery or nursing staff (70%, n=100/142). Prior to discharge, 65% of the mothers received formal debriefing with local counselling services.

Previously reported and common risk factors for stillbirth were present within our cohort. A significant number of women were anaemic (26% with a haemoglobin <100 g/L), however, haemoglobin levels were only recorded in 56% of the total cases and information regarding timing of haemoglobin testing was not available in most records. The median haemoglobin was 108 g/L for these women. Fifty-two women were not tested for syphilis. Of the 90 women who were tested for syphilis, 25% were positive (n=23/90) and only 7 of these women completed treatment. Only two case files had documentation of partner treatment. Sixteen women (11%) had experienced a prior stillbirth. Most women (78%) had at least one antenatal visit prior to their stillbirth. One-fifth

Table 1 Maternal and demographic characteristics for stillbirths with complete case files (n=142) at the National Referral Hospital, Honiara, the Solomon Islands, between January 2017 and December 2018

Variable	Frequency (%)
Age (years)	
Median age (IQR)*	28 (11)
Age <18	3 (2.1)
Age 18–35	107 (75.4)
Age >35	15 (10.6)
Missing	17 (12.0)
Parity	
Nulliparous	54 (38.0)
Multiparous (≤4 births)	75 (52.8)
Grand multiparous (≥5 births)	13 (9.2)
Body mass index (kg/m^2)	
Median BMI (IQR)	27 (9.2)
≥30	28 (19.7)
<30	39 (27.5)
Missing	75 (52.8)
Anaemia (Hb <100 g/L)	
Median Hb (IQR)	108 (27.5)
Yes	37 (26.1)
No	43 (30.3)
Unknown	52 (36.6)
Missing	10 (7.0)
Marital status	
Single	30 (21.1)
Married	100 (70.4)
Cohabiting	12 (8.5)
Education level	
None	6 (4.2)
Primary	29 (20.4)
Secondary	57 (40.1)
Tertiary	17 (12.0)
Unknown	28 (19.7)
Missing	5 (3.5)
Ethnicity	
Melanesian	132 (93.0)
Polynesian	5 (3.5)
Other†	5 (3.5)
Employment	
Employed	27 (19.0)
Unemployed/homemaker	95 (66.9)
Student	13 (9.2)
Unknown	7 (4.9)
Region of residence	
Main island‡	85 (59.9)
Other	49 (34.5)
Missing	8 (5.6)
Antenatal booking	
Booked	111 (78.2)
Unbooked	31 (21.8)
Antenatal ultrasound	
Yes	36 (25.5)
No	105 (74.5)
Location of stillbirth diagnosis	
Referred	42 (29.6)
Not referred	94 (66.2)
Missing	6 (4.2)
Accoucheur	
Consultant	9 (6.3)
Senior registrar	16 (11.3)
Junior registrar	9 (6.3)
Senior midwife	42 (29.6)
Junior midwife	4 (2.8)
Registered nurse	54 (38.0)
Student	4 (2.8)
Missing	4 (2.8)

*IQR=IQR range.
†Other ethnicity—combined Micronesian, Caucasian and Asian.
‡'Main island' refers to Guadalcanal, where the National Referral Hospital is located.
BMI, body mass index; Hb, haemoglobin.

(20%) were obese (body mass index >30), however body mass index was only recorded for 47% of the cases. All but one mother received an ultrasound during her care, however only 25% received an ultrasound in the first or second trimester. Reduced fetal movements were reported prior to attendance in 67 cases (47%). Discussion of common danger signs, such as reduced fetal movements or vaginal bleeding, were not documented for 50% of the cases.

Most women had a spontaneous vaginal birth (83%). There were 7 inductions, 2 instrumental births and 14 emergency caesarean sections (2 of which were failed inductions). Birth weight was not documented for 18 stillbirths. Of those with a recorded birth weight, 59% had a birth weight below <2500 g, with a median birth weight of 1920 g (range 500 g–4984 g, IQR 1668.5 g), and 32% extremely low birth weight (<1500 g).

The estimated median gestational age of stillbirth was 34 weeks (range 20–43 weeks, IQR 9), with 80% occurring in the third trimester (n=114/142). The majority (62%, n=88/142) of stillbirths were preterm (<37 completed

Table 2 Causes of antenatal and intrapartum stillbirth (International Classification of Diseases-PM classification) at the National Referral Hospital over a 2-year period of 2017–2018 for all cases of stillbirth where cause was documented (n=198)

Cause of death	Total (%)
Antepartum deaths	170 (85.9)
A1: Congenital malformations, deformations and chromosomal abnormalities	8 (4.7)
A2: Infection	19 (11.2)
A3: Antepartum hypoxia	19 (11.2)
A4: Other specified antepartum disorder	13 (7.6)
A5: Disorders related to fetal growth	43 (25.3)
A6: Unspecified cause	68 (40)
Intrapartum deaths	28 (14.1)
I1: Congenital malformations, deformations and chromosomal abnormalities	4 (14.3)
I2: Birth trauma	1 (3.6)
I3: Acute intrapartum event	13 (46.4)
I4: Infection	1 (3.6)
I5: Other specified intrapartum disorder	0
I6: Disorders related to fetal growth	5 (17.9)
I7: Unspecified cause	4 (14.3)

week gestation), 16% were <28 weeks completed gestation and 4% were >41 completed weeks gestation.

Of the 198 stillbirths with a recorded cause of death, 170 occurred antenatally (86%) and 28 (14%) were intrapartum (table 2). Almost half (42%) of the stillbirths were macerated and 31% were fresh, however appearance of the fetus at delivery was not documented in 26% of the cases. Table 3 demonstrates the primary cause of death associated with maternal conditions, such as maternal complications of pregnancy, labour and delivery. There were 12 cases (6%) of congenital malformations, with the majority being hydrocephalus and 1 fetus showing signs of Trisomy 21.

Among the antepartum stillbirths, cause of death was unspecified according to the ICD-PM for 40% (68/170) of the cases (table 3). Five were associated with maternal deaths, with three of these secondary to puerperal sepsis, one secondary to fulminant liver failure and one secondary to liver and renal failure resulting from severe pre-eclampsia. Half (53%) of the antenatal stillbirths were not associated with a documented concurrent maternal condition (table 3). Twenty-five per cent (n=43) of the cases were associated with low birth weight and among this group, there was also a coexisting hypertensive disorder in 28% of the cases (n=12/43). Maternal infection was present in 19 (11%) antenatal stillbirths, with 53% (n=10/19) of the fetuses showing signs of congenital syphilis. There were 19 cases of antepartum hypoxia, most of which were associated with complications of the placenta, cord and membranes (n=12/19), with 9 cases secondary to placental abruption and the remainder to trauma. Four deaths were due to termination of pregnancy via maternal use of misoprostol at between 20 and 37 weeks estimated gestation.

Of the 28 intrapartum stillbirths, 46% were due to an acute, preventable event, such as fetal asphyxia, which was evidenced by non-reassuring fetal heart rate patterns (where recorded) or loss of fetal heart rate in labour. Concurrent maternal medical or surgical conditions were present in 3 (11%) cases, with the most common being hypertensive disorders of pregnancy (n=4). Of these intrapartum deaths, three had complications of the cord, placenta or membranes (two with acute cord prolapse), and three were due to extreme prematurity. Low birth weight was present in five cases and fetal heart rate monitoring during the second stage of labour was not documented or performed for 92% of the cases.

DISCUSSION

This study is the first to investigate causes of stillbirth in the Solomon Islands. The incidence of stillbirth at the National Referral Hospital was 31 cases per 1000 births. This is almost twofold greater than the most recent WHO estimate for the Solomon Islands (17.6 per 1000 total births).[10]

Recent WHO data suggests that most (65.4%) of the women in the Solomon Islands have at least one antenatal visit.[18] This was also evident in our cohort, however we found significant gaps in the quality of care. It is well-known that many stillbirths in LMICs may be prevented through improved antenatal care. A key component of antenatal care is ultrasound assessment, however three-quarters of the women within our cohort did not receive an early ultrasound. This likely reflects the availability of antenatal ultrasound in the nation. Ultrasound imaging is vital for dating and diagnosis of anomalies and detection of suspected fetal growth restriction.[19 20] In our cohort, suspected fetal growth restriction was common (reported in 59% of the stillbirths with a documented birth weight) and of these, 80% were estimated to be over 28 weeks gestation. Neonates born >28 weeks' gestation are commonly admitted to the special care nursery in the Solomon Islands and have a survival rate of at least 40%, based on estimates from hospital records. Thus, many of these stillbirths could have been prevented if low birth weight had been detected earlier via ultrasound with adequately timed delivery of these compromised fetuses. While access to ultrasound examination is particularly challenging in this setting, expanding these services may assist in reducing stillbirths.[3 21] In addition, one-third of our cohort were living outside of the main island and one-third were referred for care, highlighting the challenges of access to high-quality antenatal care in peripheral and remote settings. These findings are shared in other studies investigating stillbirth in the neighbouring Papua New Guinea and Timor-Leste,[22 23] and highlights

Table 3 International Classification of Diseases-PM tabulation of cause of death and maternal condition separated by timing of death at the National Referral Hospital over a 2-year period of 2017–2018 for all cases of stillbirth where cause was documented (n=198)

Maternal condition	M1: Complications of placenta, cord and membranes	M2: Maternal complications of pregnancy	M3: Other complications of labour and delivery	M4: Maternal medical and surgical conditions	M5: No maternal condition	Other	Total (%)
Antepartum death							
A1: Congenital malformations, deformations and chromosomal abnormalities	0	0	0	2	6	0	8 (4.7)
A2: Infection	0	4	0	13	2	0	19 (11.2)
A3: Antepartum hypoxia	12	0	0	5	2	0	19 (11.2)
A4: Other specified antepartum disorder	5	1	0	5	2	0	13 (7.6)
A5: Disorders related to fetal growth	0	1	0	12	30	0	43 (25.3)
A6: Fetal death of unspecified cause	2	1	0	13	48	4	68 (40)
Total (%)	19 (11.2)	7 (4.1)	0	50 (29.4)	90 (52.9)	4 (2.4)	170 (85.9)
Intrapartum death							
I1: Congenital malformations, deformations and chromosomal abnormalities	0	0	0	0	4	0	4 (14.3)
I2: Birth trauma	0	0	0	0	1	0	1 (3.6)
I3: Acute intrapartum event	3	0	3	1	6	0	13 (46.4)
I4: Infection	0	0	0	1	0	0	1 (3.6)
I5: Other specified intrapartum disorder	0	0	0	0	0	0	0
I6: Disorders related to fetal growth	0	0	0	1	4	0	5 (17.9)
I7: Intrapartum death of unspecified cause	0	0	0	0	4	0	4 (14.3)
Total (%)	3 (10.7)	0	3 (10.7)	3 (10.7)	19 (67.9)	0	28 (14.1)

the importance of strengthening early and high-quality antenatal care in the Asia-Pacific.

Syphilis remains a major cause of stillbirth globally.[2 3 24] There is limited evidence regarding population prevalence of syphilis, however a recent study in the Solomon Islands 1:210 liveborn babies had evidence of congenital syphilis.[25] Routine antenatal testing is, thus, recommended as part of antenatal care.[26–28] A deficiency in testing of syphilis was evident in our cohort, with 53% (10 babies) of the 19 antenatal stillbirths associated with infection showing overt signs of congenital syphilis infection, however only one-third of the women were tested. Similarly, maternal anaemia is a major risk factor for low birth weight and stillbirth. Anaemia was common in our study and lower than the most recent prevalence data, showing 49% of the pregnant women are anaemic in the Solomon Islands.[29] Detection, and thus treatment of, anaemia and syphilis can be increased with point of care syphilis and haemoglobin testing, particularly in rural and remote settings where laboratory services are not readily available.[28 30] Point of care testing is cost-effective and could be considered in LMICs such as the Solomon Islands.[24 30]

The largest proportion of stillbirths were unclassified (or cause unknown), which is in keeping with other studies in LMICs and largely due to lack of diagnostic tools and inadequate documentation.[31 32] Additionally,

our intrapartum stillbirth rate was lower than previous studies,[1–3 22] with the recent study in Timor-Leste showing an intrapartum stillbirth rate of 33%.[22] The large number of missing case files and reliance on physical appearance to identify timing of stillbirths may have led to an under-representation of intrapartum deaths. This may also be attributable to inaccurate classification of some stillbirths as antepartum in those where case files were available, as a quarter of cases in our study did not have adequate documentation of maceration.This is certainly significant given most intrapartum stillbirths had suboptimal care. Furthermore, the overall incidence of stillbirth in the Solomon Islands was found to be higher than the average stillbirth rate for its two closest neighbours, Papua New Guinea and Fiji (rates of 15.9 and 11.9 per 1000 births, respectively).[10 22] This may be due to referral bias; however, the proportional causes of stillbirth are still likely to reflect the national rate. Furthermore, the COVID-19 pandemic is likely to have increased these numbers and gaps in care, in keeping with data from other areas of the world.[33–36]

Our study was limited by its retrospective nature and incomplete data on stillbirths, as well as incomplete data on the total number of births during the study period. Second, this study is an under-representation of all stillbirths that occur at a national level as we have only included data from the hospital setting and did not include those within the community or peripheral centres. Third, the accuracy of gestational age was limited due to the lack of routine dating ultrasounds. Finally, adequate registration of stillbirths relies on ascertainment of cause of death, which remained unspecified in many cases due to inadequate and incomplete documentation.

The true magnitude of perinatal deaths remains under-reported and underinvestigated in the Solomon Islands. Like many of its Pacific neighbours, the Solomon Islands currently does not formally register stillbirths. There is a need to optimise prospective documentation of all birth outcomes and adopt classification of all perinatal deaths, like the maternal death surveillance system. While many classification systems have been used in LMICs,[37] we successfully used the ICD-PM classification system.

CONCLUSIONS

This study revealed a high incidence of stillbirth at the National Referral Hospital and many cases deemed preventable. The ICD-PM classification system was also successfully applied to the stillbirths recorded in our study, demonstrating its potential for usage in this setting. These findings highlight the urgent need for increased focus on perinatal deaths in the Solomon Islands with universal classification and targeted training, improved quality of obstetrical care and community awareness. Effective public health interventions to tackle this global issue are more urgent than ever with the ravaging effects of COVID-19, particularly in LMICs.[33 35]

Author affiliations
[1]Obstetrics and Gynaecology, The University of Melbourne Melbourne Medical School, Melbourne, Victoria, Australia
[2]Department of Obstetrics and Gynaecology, National Referral Hospital, Honiara, Solomon Islands
[3]Department of Maternal and Child Health, Office of the WHO Representative in Solomon Islands, Honiara, Solomon Islands
[4]Ministry of Health of Solomon Islands, Honiara, Solomon Islands
[5]Department of Obstetrics and Gynaecology, University of Melbourne, Heidelberg, Victoria, Australia

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Contributors MSDS conducted the literature search. MSDS, LP, RH and LM conceived and designed this study. MSDS, LP, CH and STa completed data collection. MSDS conducted the data analysis and data interpretation and drafted the final manuscript and prepared the tables. RH, SPW, STo, ACL, SB and DO provided critical analysis and made revisions of the manuscript and important intellectual contributions. MSDS is the guarantor of this manuscript, accepting full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. All authors reviewed the manuscript before final submission.

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ORCID iDs
Manarangi Sajini De Silva http://orcid.org/0000-0002-0780-519X
Susan P Walker http://orcid.org/0000-0001-9075-4655

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