WHO DOES WELL WHERE? EXPLORING HOW SELF-RATED HEALTH DIFFERS ACROSS DIVERSE PEOPLE AND NEIGHBORHOODS

Authors
Hannah Badland, Gavin Turrell, Billie Giles-Corti

a McCaughey VicHealth Centre for Community Wellbeing, University of Melbourne, Melbourne, Australia, Level 5, 207 Bouverie Street, Carlton, VIC 3010, Australia; Email: hannah.badland@unimelb.edu.au

b School of Public Health and Social Work, Queensland University of Technology, Brisbane, Australia, Kelvin Grove Campus, Victoria Park Road, Kelvin Grove, QLD 4059, Australia; Email: g.turrell@qut.edu.au

c McCaughey VicHealth Centre for Community Wellbeing, University of Melbourne, Melbourne, Australia, Level 5, 207 Bouverie Street, Carlton, VIC 3010, Australia; Email: billie.giles-corti@unimelb.edu.au

Corresponding author
Dr Hannah Badland
McCaughey VicHealth Centre for Community Wellbeing
University of Melbourne
Level 5, 207 Bouverie Street
Carlton
VIC 3010
Australia
Email: hannah.badland@unimelb.edu.au
Telephone: +61 3 8344 0943
Fax: +61 3 9348 2832

Word count
Abstract = 108
Manuscript = 3,515
ABSTRACT
This work establishes whether neighborhood disadvantage amplifies the impact of socioeconomic position (SEP) on a graded measure of self-rated health (SRH). SRH data were taken from 10,932 adults recruited across 200 Brisbane neighborhoods. After adjusting for demographics, those who lived in the most disadvantaged neighborhoods were more likely to report poor SRH than those living in the least disadvantaged neighborhoods (OR=2.67). Those with the lowest SEP and lived in the most advantaged neighborhoods had a similar probability of reporting excellent SRH as those with the highest SEP living in the most disadvantaged neighborhoods. This work highlights the importance of examining SEP and neighborhood-level disadvantage simultaneously when planning communities.

KEYWORDS
Inequalities; adults; multilevel modeling; HABITAT; neighborhood disadvantage
MAIN TEXT

INTRODUCTION

The relationships between social inequalities and health outcomes is well established in developed countries; those who are socioeconomically disadvantaged or live in deprived neighborhoods experience higher levels of disease and die earlier compared with those more advantaged (Crombie et al., 2002, Strategic Review of Health Inequalities in England post-2010, 2010). This phenomenon manifests itself in part through compositional (individual-level) and contextual (area-level) exposures (Kawachi, 2002, Macintyre, 2007). Health and place-based research has established potential causal pathways between these exposures on health outcomes, supported by quantitative and qualitative evidence showing who you are and where you live are associated with health behaviors and outcomes (Torsheim et al., 2004, Franzini et al., 2005, Cummins et al., 2007, Chandola et al., 2003, Sacker et al., 2000, Wilkinson and Pickett, 2006, Giles-Corti and Donovan, 2003, Turrell and Mathers, 2001).

Using the deprivation amplification argument (Macintyre, 2007), compositional and contextual effects compound; that is, having a low socioeconomic position (SEP) and living in deprived areas expose individuals to double disadvantage. Conversely, there is a ‘pulling-up’ effect for those of low SEP residing in more advantaged areas. When matched by SEP, those living in less deprived areas have better health profiles than those living in more deprived areas (Cummins et al., 2007, Strategic Review of Health Inequalities in England post-2010, 2010). Earlier work suggests contextual factors have only a modest effect on explaining health outcomes when compared with compositional factors (Pickett and Pearl, 2001). More recent work using multilevel modeling, however, has further considered the complexities of health and place-based research, suggesting that the strength of associations between contextual factors and health outcomes is stronger than previously thought, but differs by the scale of administrative units applied (Giles-Corti et al., 2005), health outcomes examined, and measures of area-level exposure (Riva et al., 2007).
Self-rated health (SRH) is associated with overall mortality and morbidity across the socioeconomic spectrum (Burström and Fredlund, 2001, Kaplan and Camacho, 1983), and is influenced by both individual-level SEP and neighborhood disadvantage (Browning and Cagney, 2002, Kennedy et al., 1998, Torsheim et al., 2004, Franzini et al., 2005). Different SRH reference points are used differently by population groups; for example when asked about SRH, older adults are more likely to consider presence of chronic conditions, whereas those with higher education attainment are more likely to reflect on their general health status (Krause and Jay, 1994). However, a meta-analysis demonstrated the global measures of SRH accurately predict mortality after adjusting for functional status, depression, and co-morbidities (DeSalvo et al., 2006). Franzini et al., (2005) developed pathways for conceptualizing how neighborhood-level disadvantage (both physical and social aspects) contribute to SRH. Neighborhood-level disadvantage was associated with lower collective efficacy, trust, and social capital, and higher levels of social and physical disorder, fear of crime, and racism; demonstrating the relationship between neighborhood disadvantage and SRH is mediated by the social and physical characteristics of the area. Other work, using student data obtained from 22 countries, demonstrated additive, rather than interactive effects, of SEP and neighborhood-level disadvantage on SRH (Torsheim et al., 2004). When SEP was considered alone, the most deprived students were three times more likely to report poor SRH than the least deprived students. However, when SEP and neighborhood-level disadvantage were considered together, the most deprived students were eight times more likely to report poor SRH compared with the least deprived students (Torsheim et al., 2004). Together, this emphasizes the importance of studying the multilevel structure of disadvantage, and indeed whether there is a double disadvantage, when considering SRH.

The rationale for choosing specific indicators of SEP is often unjustified, and different measures are frequently treated as having the same conceptual underpinning and underlying constructs, despite empirical evidence suggesting otherwise (Dutton et al., 2005). Using multiple measures of SEP, such as education attainment and household income, has been suggested as a way
of revealing different patterning of socioeconomic markers on health outcomes through diverse causal pathways (Geronimus and Bound, 2007). Furthermore, education attainment and household income have established unique and predictive contributions to SRH (Lantz et al., 2001). These two measures of SEP are appropriate for the ‘baby boomer’ population being investigated here (i.e., those born between 1946 and 1964), as most have attained their highest qualification and career advancement, therefore near maximum earning potential at the time of being studied.

As well as conceptual considerations, a further limitation of research using SRH as an outcome is that the measure is frequently collapsed into a dichotomy (poorer versus better SRH), despite being initially assessed on a three- or five-point scale (Power et al., 1998, Mackenbach et al., 1997, Rahkonen et al., 1995). Using this reductionist data treatment approach potentially obscures important patterns of SRH and results in a loss of information and statistical efficiency (Agresti, 1984). An approach that considers SRH in a more sensitive manner (i.e., using a multinomial rather than binomial outcome) contributes further to our understanding of the outcome as a continuum in relation to measures of disadvantage (Manor et al., 2000).

Taking into account this earlier work, we are interested in exploring how different exposures to disadvantage may result in inequalities for SRH in middle-aged adults, living in a relatively affluent country (Australia) (United Nations Development Program, 2011). We believe it reasonable to expect education attainment and household income to be independently, and differently associated with SRH, with the strength of these associations varying by neighborhood-level disadvantage. The first aim of this paper was to establish the multilevel relationship of disadvantage on categorical responses of SRH in middle-aged Australian adults. The second aim was to examine the association between two measures of SEP on categorical responses of SRH, and whether these differed across neighborhoods that varied by disadvantage. We explore whether double disadvantage exists for those with low SEP in the Australian context, and the protective effects, if any, that living in more affluent neighborhoods may provide. We unpack these relationships using multilevel approaches and finer-grained measures of SRH.
METHODS

This research uses the 2007 survey data (wave I) of the HABITAT (How Areas in Brisbane Influence Health and Activity) study. HABITAT is a longitudinal (2007 - 2011) study of ‘baby boomer’ women and men living in Brisbane, Australia. Detailed information about the study can be found elsewhere (Burton et al., 2009). HABITAT was granted ethical approval by The University Human Research Ethics Committee at the Queensland University of Technology (ID3967H).

Study areas

The Census Collection District (CCD) was the primary sampling unit. Containing approximately 200 households, these are the smallest administration units used by the Australian Bureau of Statistics to collect census data. For this study, the 1,625 contiguous CCDs in Brisbane were ranked based on their Index of Relative Socioeconomic Disadvantage (IRSD) scores. Comprising of 17 attributes, the IRSD is a composite area-level measure reflecting, amongst other things, the proportion of low-income families, low educational attainment, and employment in unskilled occupations for those who reside in the CCD. The IRSD is an ecologic exposure derived by aggregating individual responses to questions asked on the national census form. When testing for an ecologic effect with aggregated exposure it is necessary to simultaneously model individual-level variables (e.g., income) and their neighborhood-level analogues (e.g., % of low income households) (Subramanian et al., 2007). As such, in line with previous work (Turrell et al., 2010), we included five individual-level controls in the multilevel analyses: age, sex, education attainment, household income, and employment status; each of which has an area-level analogue represented in the IRSD.

Neighborhood-level measures

CCDs were divided into quintiles based on IRSD scores (quintile 1 (Q1) = most disadvantaged neighborhoods through to quintile 5 (Q5) = most advantaged neighborhoods). Forty CCDs were
randomly selected within each quintile of neighborhood disadvantage, totaling 200 CCDs overall. The sampled CCDs reflected the non-sampled CCDs (Burton et al., 2009).

Participants

Households containing at least one person aged 40 – 65 years as at March 2007 within selected CCDs were identified through the Australian Electoral Commission. An average of 85 households per CCD was sampled using systematic without replacement probability proportional-to-size sampling. One person aged 40 – 65 years was randomly selected and invited to participate in the study from each of the 17,000 identified households. After excluding surveys that were subsequently deemed out-of-scope (e.g. deceased, left-address, too ill or disabled to participate) a total of 11,037 eligible and useable surveys were returned (68.5% response rate).

Individual-level measures

Individual-level data were collected using a structured self-administered mail survey during May – July 2007 (Dillman, 2000). The outcome measure of interest in this paper is SRH, where participants responded to the question: ‘In general, would you say your health is?’ Response options were: excellent, very good, good, fair, and poor. As has been done elsewhere (Ericksson et al 2001), SRH was collapsed to excellent (excellent and very good), good (good), and poor (fair and poor).

Statistical analysis

Cases with missing SRH data (n = 105) were removed prior to analysis, reducing the analytic sample to 10,932 adults. A four-stage modeling approach was used. Using multinomial unordered logistic regression, Model I examines the association between household income and SRH adjusted for neighborhood disadvantage; Model II examines the association between education attainment and SRH adjusted for neighborhood disadvantage; Model III examines the association between neighborhood disadvantage and SRH unadjusted for individual-level SEP; and Model IV included
Model III plus adjustment for sex, age, education attainment, household income, and employment status. All models quantified the between neighborhood variance in the probability of reporting poor and good SRH. Excellent SRH was used as the reference category.

As recommended (Browne, 2009), the multilevel logistic model parameters were estimated using Markov chain Monte Carlo (MCMC) simulation. MCMC is a Bayesian statistical approach based on a priori assumptions, and is able to model complex statistical relationships by producing simulated draws of the data based on the output values from the posterior distribution. We used the Metropolis Hastings algorithm implemented for 100,000 iterations, specifying non-informative prior distributions on all model parameters. Convergence was checked using the Raftery-Lewis and Brooks-Draper diagnostic tests. Results are reported as odds ratios and their 95% credible intervals (CrI). Cross-level interactions were used to explore categories of SRH and neighborhood disadvantage by household income and education attainment. These cross-level interaction models were adjusted by sex, age, education attainment, employment status, and household income. All analyses were conducted using MLwiN v.2.24 (University of Bristol, Bristol).

RESULTS
Overall, 17.8% of participants reported poor SRH, 38.3% reported good SRH, and 43.8% reported excellent SRH. Those living in the most disadvantaged neighborhoods were less likely to have qualifications above school-level, were more likely to have a lower household income, and to not be in paid employment compared with those living in more advantaged neighborhoods (Table 1).

[Insert Table 1 about here]

Those of lower SEP, and those living in more disadvantaged neighborhoods were more likely to report poor or good (rather than excellent) SRH; conversely those of higher SEP and living in more advantaged neighborhoods were less likely to report poor or good SRH (Table 2). The probability of
reporting poor or good SRH generally increased across as SEP became lower or neighborhoods became more disadvantaged. After controlling for SEP attributes (Table 2, Model IV), those who lived in the most disadvantaged neighborhoods remained nearly three times (OR = 2.67; 95% CI = 2.13 – 3.34) more likely to report poor SRH than those living in the most advantaged neighborhoods. A similar, but less strong association remained between neighborhood disadvantage and good SRH (excellent SRH was the reference category) with those who lived in the most disadvantaged neighborhoods being nearly twice as likely (OR = 1.78; 95% CI = 1.35 – 2.10) to report poor SRH than those living in the most advantaged neighborhoods.

[Insert Table 2 about here]

Data presented in Table 3 reflect SRH variation between the 200 neighborhoods across the five models. Raftery-Lewis and Brooks-Draper diagnostic testing supported that 100,000 iterations were appropriate to generate predictive model fits. For all models, the variation in SRH across the neighborhoods was statistically significant. The magnitude of variation for poor SRH was larger between the neighborhoods when compared with other SRH classifications. For the fully adjusted model (Model IV), the probability of reporting SRH for the 200 neighborhoods varied significantly around the Brisbane average (poor SRH: $\sigma^2=0.069(0.019)$; good SRH: $\sigma^2=0.038(0.009)$; excellent SRH: $\sigma^2=0.029(0.010)$).

[Insert Table 3 about here]

Cross-level interactions examined the association between household income and categories of SRH across different levels of neighborhood disadvantage, after adjusting for other individual-level confounders (Fig. 1). Similar magnitudes and directions across the quintiles of neighborhood disadvantage were shown within each category of SRH. Within each quintile of neighborhood
disadvantage, those with the lowest household income were most likely to report poor SRH and least likely to report excellent SRH. As neighborhoods became more advantaged an incremental reduction in reporting poor SRH was evident; the reverse relationship was evident for excellent SRH. Notably, those who had the lowest household income and lived in the most advantaged neighborhoods had a similar probability of reporting excellent SRH as those with the highest level of household income and residing in the most disadvantaged neighborhoods. No such association was observed for those reporting good SRH.

[Figure 1 about here]

Figure 2 shows the cross-level interactions for education attainment, neighborhood disadvantage, and SRH, after adjusting for other individual-level confounders. As with household income, the probability of reporting excellent SRH was highest in the most advantaged neighborhoods across all education levels, including those respondents with the lowest levels of education. For any given quintile, those educated to school level or lower were less likely than others to report excellent SRH; the inverse relationship was shown with poor SRH. Although not as strong as household income, those educated to school level only and living in the most advantaged neighborhoods (Q4, Q5) had a lower probability of reporting poor SRH than those holding a Bachelor degree or higher who lived in most disadvantaged neighborhoods (Q1, Q2).

[Insert Figure 2 about here]

For both SEP measures, patterning within quintiles of neighborhood disadvantage did not differ for the cross-level interactions, and is supported by the non-significant Wald tests (household income Wald test = 2.639, p-value = 0.104; education attainment Wald test = 2.608, p-value = 0.106).
DISCUSSION

Our findings support well-established associations between health and disadvantage, suggesting that even in a relatively affluent country like Australia that experiences a high quality of life (United Nations Development Program, 2011), those receiving lower household incomes are doubly disadvantaged if they live in less affluent neighborhoods. This inequality attenuates if they live in more advantaged neighborhoods. After accounting for common compositional variables, neighborhood-level disadvantage was associated with SRH, with this relationship being most pronounced for reporting poor SRH. Perhaps more importantly, our findings suggest there is a neighborhood-level protective buffering effect operating; those with the lowest household incomes living in more advantaged neighborhoods have a similar probability of excellent SRH as those with the highest household incomes living in the most disadvantaged areas. Put more simply, it is better to be poor in an affluent neighborhood, than poor in a disadvantaged neighborhood; this aligns with the amplification effects of disadvantage outlined by others (Macintyre, 2007, Cummins et al., 2007).

Although not explored here, it may be that people who live in more advantaged areas have greater access to stable employment opportunities, healthier food options, and better quality schools and housing (Macintyre et al., 2002). Moreover, as the neighborhood-level measure used in this study related to the composition of the local residents, it is likely that the collective social functioning of neighborhoods may contribute to this relationship by influencing shared norms, values, and practices (Macintyre et al., 2002). The adaptive capacity, that is the ability to respond positively to changing systems through governance, behavior, resources, and innovation (Jones et al., 2010), was also not examined for neighborhoods across the spectrum of disadvantage. Thus, advantaged neighborhoods may influence the health status of residents of lower SEP by both reducing material deprivation and / or providing a more resilient social environment (Strategic Review of Health Inequalities in England post-2010, 2010).
We used education attainment as a distal and therefore more stable measure of
disadvantage, and household income as a more temporal proximal measure of exposure to
disadvantage. Yet, it is highly plausible that some people have lived in low-income households all of
their lives, as well as attaining a low level of education. Social pathways to health research have
shown low childhood socio-economic circumstance transmits to low education attainment, which in
turn, leads to low socio-economic status in adulthood (Marmot and Wilkinson, 1999, Kuh and Ben-
Shlomo, 2004, Dutton et al., 2005). As such, our measures of SEP should not be considered as
mutually exclusive, but instead serve to examine different angles of the relationship of SEP on SRH.
For example, education attainment was not as consistently related to SRH compared with household
income. It may be the grading effect of education was less important than that of household income
when SRH is considered (Davey Smith et al., 1998). To support this argument, Salhi et al.,(1995)
identified mortality risk in 180,000 adults was significantly higher for men and women whose formal
education stopped at ‘school only’ than at other higher levels of education attainment. Our data
support the use of this threshold; across the quintiles of neighborhood disadvantage, those who had
a school level or lower education were more likely to report poor SRH, whereas the other education
groups had similar probabilities.

By employing a multinomial outcome of SRH we demonstrated that measures of individual-
and neighborhood-level disadvantage have the strongest associations at either end of the spectrum.
This supports earlier work by Macintyre et al.,(2002) and Torsheim et al.,(2004) showing
compositional and contextual factors do not contribute equally across the socioeconomic spectrum.
Furthermore, by using multilevel modeling approaches we have shown that SEP and neighborhood
disadvantage impact on SRH in the Australian context.

As well as understanding what the measure of SRH captures, aspects of the neighborhood
environment that protect health need to be isolated. Once these elements have been identified,
neighborhood-level interventions could be identified to optimize population health outcomes. This
information could guide policy makers to better support health outcomes in residents. In particular,
improving infrastructure that supports the social determinants of health, such as access to public transport and employment opportunities, in more disadvantaged neighborhoods will help reduce health and social inequalities (Strategic Review of Health Inequalities in England post-2010, 2010). Environmental modifications may be particularly important in settings where large number of low income earners are concentrated, as they potentially have reduced opportunities to access health care (Andersen et al., 2002) and other resources (Kumanyika and Grier, 2006, Sampson, 2011). Another potential intervention is creating policies and infrastructure provision to support an increased mix of residents across the socio-economic spectrum. Examples of such area-based interventions include the New Deal for Communities (UK) (Stafford et al., 2008) and Hope IV (US) (Popkin et al., 2004). Future work could ascertain how these interventions relate to changes in SRH. Together, these interventions have the potential to both reduce material deprivation, while providing access to health-enhancing social infrastructure designed to increase neighborhood liveability (Giles-Corti et al., 2010).

There are limitations to this research that may influence our findings. First, approximately 30% of invited adults did not participate in the study. Second, the neighborhoods were defined on the basis of ABS-derived administrative units (CCDs). This artificial application of using CCDs as ‘neighborhoods’ may be unrelated to how respondents define their neighborhood, and may over- or under-estimate the effect neighborhood disadvantage on SRH. Third, this study was cross-sectional, therefore causality cannot be inferred. Fourth, we have not attempted to identify and isolate neighborhood environment features that are protective of health. Fifth, the outcome measure is broad both biologically and socially. Although it has been shown to be predictive of mortality (Kaplan and Camacho, 1983) and is recommended for standard health surveys (Robine et al., 2003), SRH may show weaker associations than if other more specific health conditions were examined. Sixth, we did not examine how long people had lived in their neighborhood, and whether SRH differed for those who had more recently moved into the area. Finally, we have treated education attainment as a long-term measure of SEP and household income as a short-term measure of SEP. Education
attainment and household income are likely to be temporally related, in so much that education influences the type of employment obtained, which in turn influences the level of income earned (Dutton et al., 2005, Marmot and Wilkinson, 1999).

Nevertheless, this work highlights the importance of examining not only individual- and neighborhood-level measures of disadvantage simultaneously to examine how double disadvantage influences SRH, but also considering multiple measures of SEP. Using a more sensitive analysis of SRH detects stronger relationships for poor and excellent outcomes, and demonstrates protective neighborhood-level effects operating for SRH, even in a relatively affluent country such as Australia (United Nations Development Program, 2011). Our work supports the use of multilevel models to test these associations, and highlights the importance of considering multi-faceted interventions that are embedded within a socio-ecological framework to improve individual- and area-level disadvantage.

COMPETING INTERESTS
The authors declare they have no competing interests.

FUNDING
HABITAT is supported by two (Australian) National Health and Medical Research Council Project Grants (ID 339718, 497236). GT is supported by an (Australian) National Health and Medical Research Council Senior Research Fellowship (ID 1003710). BGC is supported by an (Australian) National Health and Medical Research Council Principal Research Fellowship (ID 1004900).
REFERENCES


Table 1: Demographic profile of 2007 HABITAT respondents stratified by neighborhood disadvantage

<table>
<thead>
<tr>
<th>Neighborhood disadvantage (quintiles)</th>
<th>Q1 (most disadvantaged)</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5 (most advantaged)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>683 42.3</td>
<td>783 43.7</td>
<td>1,057 46.3</td>
<td>1,167 44.0</td>
<td>1,143 44.1</td>
<td>0.407</td>
</tr>
<tr>
<td>Female</td>
<td>932 57.7</td>
<td>1,008 56.3</td>
<td>1,224 53.7</td>
<td>1,486 56.0</td>
<td>1,449 55.9</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 - 44</td>
<td>304 18.8</td>
<td>374 20.9</td>
<td>481 21.1</td>
<td>534 20.1</td>
<td>530 20.4</td>
<td>0.006</td>
</tr>
<tr>
<td>45 - 49</td>
<td>330 20.4</td>
<td>403 22.5</td>
<td>494 21.7</td>
<td>613 23.1</td>
<td>571 22.0</td>
<td></td>
</tr>
<tr>
<td>50 - 54</td>
<td>346 21.4</td>
<td>349 19.5</td>
<td>430 18.9</td>
<td>566 21.3</td>
<td>556 21.5</td>
<td></td>
</tr>
<tr>
<td>55 - 59</td>
<td>297 18.4</td>
<td>333 18.6</td>
<td>438 19.2</td>
<td>494 18.6</td>
<td>513 19.8</td>
<td></td>
</tr>
<tr>
<td>60 - 65</td>
<td>338 20.9</td>
<td>332 18.5</td>
<td>438 19.2</td>
<td>446 18.6</td>
<td>422 16.3</td>
<td></td>
</tr>
<tr>
<td>Education attainment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School only</td>
<td>872 54.0</td>
<td>794 44.3</td>
<td>967 42.4</td>
<td>984 37.1</td>
<td>655 25.3</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Certificate</td>
<td>327 20.2</td>
<td>344 19.2</td>
<td>453 19.9</td>
<td>468 17.6</td>
<td>346 13.3</td>
<td></td>
</tr>
<tr>
<td>Diploma</td>
<td>132 8.2</td>
<td>200 11.2</td>
<td>244 10.7</td>
<td>334 12.6</td>
<td>354 13.7</td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree or higher</td>
<td>278 17.2</td>
<td>446 24.9</td>
<td>607 26.6</td>
<td>860 32.4</td>
<td>1,235 47.6</td>
<td></td>
</tr>
<tr>
<td>Household income (AUD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>$26,000 - $41,599</td>
<td>281 17.4</td>
<td>231 12.9</td>
<td>259 11.4</td>
<td>264 10.0</td>
<td>148 5.7</td>
<td></td>
</tr>
<tr>
<td>$41,600 - $51,999</td>
<td>153 9.5</td>
<td>181 10.1</td>
<td>187 8.2</td>
<td>171 6.4</td>
<td>119 4.6</td>
<td></td>
</tr>
<tr>
<td>$52,000 - $72,799</td>
<td>234 14.5</td>
<td>314 17.5</td>
<td>398 17.4</td>
<td>386 17.4</td>
<td>281 10.8</td>
<td></td>
</tr>
<tr>
<td>$72,800 - $129,999</td>
<td>274 17.0</td>
<td>451 25.2</td>
<td>605 26.5</td>
<td>785 29.6</td>
<td>710 27.4</td>
<td></td>
</tr>
<tr>
<td>≥ $130,000</td>
<td>86 5.3</td>
<td>158 8.8</td>
<td>264 11.6</td>
<td>518 19.5</td>
<td>851 32.8</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>247 15.3</td>
<td>241 13.5</td>
<td>354 15.5</td>
<td>367 13.8</td>
<td>386 14.9</td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Not in the labour force</td>
<td>498 30.8</td>
<td>406 22.7</td>
<td>527 23.1</td>
<td>501 18.9</td>
<td>496 19.1</td>
<td></td>
</tr>
<tr>
<td>Blue collar workers</td>
<td>337 20.9</td>
<td>330 18.4</td>
<td>355 15.6</td>
<td>327 12.3</td>
<td>196 7.6</td>
<td></td>
</tr>
<tr>
<td>White collar workers</td>
<td>344 21.3</td>
<td>415 23.2</td>
<td>542 23.8</td>
<td>629 23.7</td>
<td>473 18.2</td>
<td></td>
</tr>
<tr>
<td>Professionals and managers</td>
<td>308 19.1</td>
<td>487 27.2</td>
<td>666 29.2</td>
<td>966 36.4</td>
<td>1,227 47.3</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>128 7.9</td>
<td>153 8.5</td>
<td>191 8.4</td>
<td>230 8.7</td>
<td>200 7.7</td>
<td></td>
</tr>
<tr>
<td>Self-rated health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Poor</td>
<td>451 27.9</td>
<td>365 20.4</td>
<td>436 19.1</td>
<td>381 14.4</td>
<td>317 12.2</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>690 42.7</td>
<td>701 39.1</td>
<td>909 39.9</td>
<td>1,018 38.4</td>
<td>876 33.8</td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>474 29.3</td>
<td>725 40.5</td>
<td>936 41.0</td>
<td>1,254 47.3</td>
<td>1,399 54.0</td>
<td></td>
</tr>
</tbody>
</table>
**Table 2:** Likelihood of reporting poor and good self-rated health by neighborhood disadvantage and SEP§

### Model I

<table>
<thead>
<tr>
<th>Household income (AUD)</th>
<th>Poor self-rated health</th>
<th>Good self-rated health</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ $130,000 (most advantaged)</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>$72,800 - $129,999</td>
<td>0.98 0.84 - 1.14</td>
<td>1.12 1.00 - 1.24</td>
</tr>
<tr>
<td>$52,000 - $72,799</td>
<td>1.23 1.03 - 1.47</td>
<td>1.17 1.03 - 1.34</td>
</tr>
<tr>
<td>$41,600 - $51,999</td>
<td>1.57 1.25 - 1.97</td>
<td>1.34 1.14 - 1.61</td>
</tr>
<tr>
<td>$26,000 - $41,599</td>
<td>1.99 1.66 - 2.41</td>
<td>1.44 1.24 - 1.68</td>
</tr>
<tr>
<td>&lt; $25,999 (most disadvantaged)</td>
<td>4.56 3.77 - 5.53</td>
<td>1.84 1.54 - 2.19</td>
</tr>
</tbody>
</table>

### Model II

<table>
<thead>
<tr>
<th>Education attainment</th>
<th>Poor self-rated health</th>
<th>Good self-rated health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor’s degree or higher (most advantaged)</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Diploma</td>
<td>0.97 0.79 – 1.18</td>
<td>1.03 0.89 – 1.19</td>
</tr>
<tr>
<td>Certificate</td>
<td>1.22 1.02 – 1.44</td>
<td>1.38 1.22 – 1.56</td>
</tr>
<tr>
<td>School only (most disadvantaged)</td>
<td>2.01 1.76 – 2.30</td>
<td>1.51 1.36 – 1.67</td>
</tr>
</tbody>
</table>

### Model III

<table>
<thead>
<tr>
<th>Neighborhood disadvantage (quintiles)</th>
<th>Poor self-rated health</th>
<th>Good self-rated health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q5 (most advantaged)</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Q4</td>
<td>1.31 1.06–1.61</td>
<td>1.29 1.13–1.46</td>
</tr>
<tr>
<td>Q3</td>
<td>2.03 1.63–2.52</td>
<td>1.55 1.34–1.78</td>
</tr>
<tr>
<td>Q2</td>
<td>2.17 1.73–2.70</td>
<td>1.53 1.32–1.77</td>
</tr>
<tr>
<td>Q1 (most disadvantaged)</td>
<td>4.23 3.35–5.29</td>
<td>2.34 2.00–2.74</td>
</tr>
</tbody>
</table>

### Model IV

<table>
<thead>
<tr>
<th>Neighborhood disadvantage (quintiles)</th>
<th>Poor self-rated health</th>
<th>Good self-rated health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q5 (most advantaged)</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Q4</td>
<td>1.37 1.17–1.60</td>
<td>1.20 1.03–1.40</td>
</tr>
<tr>
<td>Q3</td>
<td>1.89 1.58–2.26</td>
<td>1.34 1.13–1.56</td>
</tr>
<tr>
<td>Q2</td>
<td>1.64 1.33–2.03</td>
<td>1.19 1.04–1.47</td>
</tr>
<tr>
<td>Q1 (most disadvantaged)</td>
<td>2.67 2.13–3.34</td>
<td>1.78 1.35–2.10</td>
</tr>
</tbody>
</table>

**Key:** CrI = Credible intervals; ref = reference category

§ Models are conditional on the three-level self-rated health outcome, with excellent self-rated health used as the reference category in all models.

Model I: Household income on SRH, adjusted for neighborhood disadvantage
Model II: Education attainment on SRH, adjusted for neighborhood disadvantage
Model III: Neighborhood disadvantage on SRH
Model IV: Model III plus adjustment for sex, age, education attainment, household income, and employment status
Table 3: Posterior means and standard error estimates obtained using MCMC simulation for between-neighborhood variation in Logit self-rated health

<table>
<thead>
<tr>
<th></th>
<th>Poor self-rated health</th>
<th>Good self-rated health</th>
<th>Excellent self-rated health</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Posterior mean (SE)</td>
<td>Posterior mean (SE)</td>
<td>Posterior mean (SE)</td>
</tr>
<tr>
<td>Unconditional model</td>
<td>0.321(0.050)</td>
<td>0.091(0.017)</td>
<td>0.167(0.027)</td>
</tr>
<tr>
<td>Model I</td>
<td>0.192(0.037)</td>
<td>0.060(0.014)</td>
<td>0.103(0.020)</td>
</tr>
<tr>
<td>Model II</td>
<td>0.242(0.042)</td>
<td>0.060(0.014)</td>
<td>0.107(0.021)</td>
</tr>
<tr>
<td>Model III</td>
<td>0.076(0.020)</td>
<td>0.016(0.005)</td>
<td>0.034(0.009)</td>
</tr>
<tr>
<td>Model IV</td>
<td>0.069(0.019)</td>
<td>0.038(0.009)</td>
<td>0.029(0.010)</td>
</tr>
</tbody>
</table>

Key: SE = standard error

Model I: Neighborhood variation in SRH after adjusting for within-neighborhood variation in household income and between-neighborhood differences in disadvantage Household income on SRH, adjusted for neighborhood disadvantage

Model II: Neighborhood variation in SRH after adjusting for within-neighborhood variation in education attainment and between-neighborhood differences in disadvantage

Model III: Neighborhood variation in SRH after adjusting for between-neighborhood differences in disadvantage

Model IV: Model III plus adjustment for sex, age, education attainment, household income, and employment status
Figure 1: Cross-level interaction for annual household income, neighborhood disadvantage, and self-rated health (adjusted for sex, age, education, and employment)
Figure 2: Cross-level interaction for education attainment, neighborhood disadvantage, and self-rated health (adjusted for sex, age, household income, and employment)
HIGHLIGHTS

- Neighbourhood disadvantage amplified the impact of individual-level SEP on SRH.
- Using a graded measure of SRH detected stronger relationships for poor and excellent outcomes.
- Individual- and area-level disadvantage measures should be considered simultaneously when examining SRH.
Author/s:
Badland, H; Turrell, G; Giles-Corti, B

Title:
Who does well where? Exploring how self-rated health differs across diverse people and neighborhoods

Date:
2013-07-01

Citation:
Badland, H; Turrell, G; Giles-Corti, B, Who does well where? Exploring how self-rated health differs across diverse people and neighborhoods, HEALTH & PLACE, 2013, 22 pp. 82 - 89

Publication Status:
Accepted manuscript

Persistent Link:
http://hdl.handle.net/11343/44140