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Poor housing quality: Prevalence and health effects

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ABSTRACT

Housing is a central component of productive, healthy, and meaningful lives, and a principle social determinant of health and well-being. Surprisingly, though, evidence on the ways that housing influences health in Australia is poorly developed. This stems largely from the fact that the majority of the population are accommodated in good quality housing. The dominance of a "good housing paradigm" means that households living in poor quality and unhealthy housing are doubly disadvantaged—by the quality of their housing and because policy makers in Australia do not acknowledge the health effects of housing. In this article, we examine the relationship between health outcomes and quality of housing. We base our analysis on data from the Household Income and Labour Dynamics in Australia (HILDA) survey, a panel dataset that is representative across Australia. We find a sizeable, policy-important, and to date under-acknowledged cohort of Australians whose health is influenced by poor-condition dwellings.

KEYWORDS

Australia; health inequalities; HILDA survey; housing; housing quality; panel data analysis

Since the foundation work of John Snow (1855) almost 200 years ago, our understanding of the important role of housing in creating and protecting the health and well-being of people has increased incrementally. Building from an initial drive amongst researchers such as Snow to establish a link between dwelling quality/conditions and human health, research into the relationship between housing and health has built a much more fine-grained conceptualization of the role of housing as a social determinant of health. It has moved beyond the "bricks and mortar" of basic housing and sanitary conditions. Housing is now well established as influencing individual health and well-being through broad-scale, direct and indirect mechanisms, such as location, affordability, tenure security, and access to social and employment networks. Partly reflecting this evolution towards a more complex understanding of the relationship between housing and health, in Australia, the majority of work within the field now looks beyond basic housing conditions. The evolution of analysis away from basic housing conditions as a

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determinant of health has been based on the view that for the non-Indigenous population, there is little evidence of negative health effects of poor quality dwellings in Australia. This is because a great majority of Australians live in good quality housing (Paris, 1993), the stock is modern by international standards, and the population is concentrated in climatically milder regions around the coast. Thus, many of the traditional markers of risk (including damp, cold, indoor air quality, and safety) established in international literature (e.g., Bonnefoy, Braubach, Krapavickaite, Ormand, & Zurlyte, 2003) have little influence in Australia.

Our previous work has contributed to this understanding, exploring the role of housing affordability (Baker, Bentley, & Mason, 2013; Bentley, Baker, & Mason, 2012; Bentley, Baker, Mason, Subramanian, & Kavanagh, 2011), tenure (Mason, Baker, Blakely, & Bentley, 2013), and precariousness (Mallett et al., 2011) in influencing health and well-being. This work has begun to highlight the need to re-examine housing conditions as an important determinant of health in Australia. Large scale rigorous analyses at the population level have shown no evidence that housing conditions have a direct impact on health in Australia. However, recent work (e.g., Beer, Baker, Raftery, & Wood, 2011; Mallett et al., 2011) and smaller scale qualitative studies have identified a cohort of Australians whose housing conditions are very poor, but who remain statistically hidden in population-level analyses. Given this "hidden fraction" also often report poor health, we suspect that they possess the double disadvantage of living in a nation where there is limited acknowledgement of housing problems, while occupying housing that significantly affects their health (Baker, Bentley, Mason, Lester, & Beer, 2013).

This article presents an empirical examination of the relationship between the characteristics of the hidden fraction and their health. We base the analysis on data from six annual waves of the Household Income and Labour Dynamics in Australia (HILDA) panel dataset. We focus on the prevalence and classification of dwelling condition related to resident characteristics to develop a profile of those Australians who live in poor quality dwellings. The second part of the article uses micro-econometric modeling to analyze the relationship between dwelling condition and health. By using longitudinal models controlling for initial health status, we establish statistical evidence of a causal relationship between poor quality housing and health for Australia's Hidden Fraction.

Dwelling condition and health in Australia

Internationally, there is a well-developed literature linking poor quality housing to poor health, including respiratory illness (e.g., Bonnefoy et al., 2003), mental and physical health (e.g., Howden-Chapman & Wilson,

2000), cardiovascular disease (e.g., Clinch & Healy, 2000), and obesity (e.g., Schoeppe & Braubach, 2007). A 2011 examination of systematic reviews highlighted the fact that among health-related interventions targeted at improving internal dwelling quality, "warmth and energy efficiency seemed to have the clearest positive impacts on health" (Gibson, Petticrew, Bambra, Sowden, & Wright, 2011, p. 181). Dwelling characteristics were shown to affect general health, respiratory health, and mental health. An earlier systematic review (Thomson, Thomas, Sellstrom, & Petticrew, 2009) of the health impacts associated with housing improvement showed that there was convincing evidence that improvements in housing resulted in health improvements. Interventions targeting warmth were likely to be the most effective housing intervention to bring about improvement in individual health. Similar findings are reflected in other primary studies. One UK-based study (Evans, Hyndman, Stewart-Brown, Smith, & Petersen, 2000) suggested that damp and cold were key housing factors associated with most health outcomes and, further, that the interaction between damp and cold exacerbated the impact on health. Similarly, Free, Howden-Chapman, Pierse, and Viggers (2010), in a study in NewZealand, found that warming (using non-polluting home heating) the homes of children with asthma improved child health, measured by a reduction in days absent from school. A comparable UK intervention study looked at the effect of improving the thermal quality of cold housing, and found marked improvements across blood pressure, self-assessed health, and respiratory health (Lloyd, McCormack, McKeever, & Syme, 2008). Similarly, Barton, Basham, Foy, Buckingham, and Somerville (2007) found statistically significant respiratory improvements (both asthma and non-asthma related) in a housing intervention group in the United Kingdom.

Mental health appears to be the second major dimension of health associated with dwelling quality. A major review of the evidence on the relationship between housing and health undertaken by Evans, Wells, and Moch (2003) found substantial empirical support across 38 studies that the quality of the housing influences emotional distress, mental health, anxiety, and depression. Similarly, a Canadian study (Gifford & Lacombe, 2006) found significant association between the physical quality of the dwelling and children's socio-emotional health, thus supporting the conclusions of Evans, Saltzman, and Cooperman (2001, p. 394) that "children living in lower-quality housing, independent of household income, have greater symptoms of psychological distress."

Very few studies examining the health outcomes of housing condition have been undertaken in Australia (Phibbs & Thompson, 2011). The majority of Australian research has focused on the well-acknowledged housing problems of the Indigenous population (e.g., Pholeros, Rainow, & Torzillo, 1993; Shepherd, Li, Mitrou, & Zubrik, 2012; Torzillo et al., 2008). Among the few

peer-reviewed studies in non-Indigenous Australians, there is evidence of a relationship between external dwelling condition and child physical health (Dockery, Ong, Colquhoun, Li, & Kendall, 2013), a spatial relationship between crowding and morbidity (largely due to respiratory diseases) in a major capital city (Beggs & Siciliano, 2001), and the lower health status of individuals in overcrowded dwellings (Waters, 2001). In recognizing this gap in the literature, this article seeks to identify groups within Australia who, in addition to the Indigenous population, live in poor quality housing and have poor health, and to examine empirical evidence of a causal relationship.

Methods

Describing the data

The HILDA longitudinal survey follows Australian individuals and households over time. The dataset is based on a nation-wide probability sample of Australian households and collects detailed longitudinal information across health, housing, employment, and demographic characteristics. Information in this dataset is collected from all household members aged 15 years and over via self-completion questionnaires and face-to-face surveys (see Wooden & Watson, 2007). As part of this survey, the dwelling condition of surveyed households was assessed. In six waves of the survey, collectors were required to rank the respondent household's dwelling condition on a five-point scale (very good–excellent; good; average; poor; very poor–derelict). The analytic dataset is comprised of each of the six years in which this dwelling condition assessment was made.

Dwelling condition in this dataset is assessed by survey collectors who were required to rank external dwelling condition and quality at the time of interview on a five-point scale (from derelict to excellent). We note that this categorization represents the subjective views of individual surveyors. In order to assess the reliability of this data as a measure of housing condition, we conducted a series of sensitivity analyses. External condition assessments for dwellings were analyzed for variability over time in order to reflect consistency of each dwelling's assessment across different assessors. This analysis showed the assessments to be relatively stable. Overall, 77% of all dwellings were assessed as being in the same category in a subsequent wave of data collection. Eleven percent recorded an improvement in dwelling condition assessment, a similar proportion (12%) recorded a worse assessment, and importantly, only a very small proportion (2%) of all dwellings were assessed as moving from excellent to derelict or derelict to excellent. A further sensitivity analysis comparing the stability of housing condition assessment of dwellings for those who moved residence (movers) showed that movers were

substantially more likely to have a changed dwelling condition assessment (24% had improved dwelling conditions and 18% had worse dwelling conditions after their move). This is consistent with previous findings (for example Pevalin, Taylor and Todd 2008, who showed that residential mobility is more likely to result in improved housing conditions). Although we acknowledge the limitation of this single subjective measure of housing condition, the HILDA dataset is currently the only large-scale, representative, and longitudinal Australian dataset to include any indicator of housing condition, thus enabling examination of its effect on the health of Australians.

Analytical plan

The analytical in this article is twofold: first, we establish a non-random association between the hidden fraction population, and health and socio-economic and demographic measures using straightforward cross-tabulations with statistical tests for random distribution (using the likelihood ratio chi-squared statistic). This builds on the methodology and findings from an initial analysis (Baker et al., 2013). We then use a linear longitudinal (panel) econometric model to analyze the relationship between dwelling condition and various measures of well-being: self-assessed mental, physical, and general health. We control in our models for key demographic and socio-economic characteristics.

An econometric model must specify the dependent variable (the outcome) and the set of explanatory variables that are expected to influence the outcome. Thus, the general longitudinal model is specified as:

$$\text{Outcome}_{it} = \alpha + \sum_{d=1}^{3} \lambda_d \text{DwellCond}_{dt} + \sum_{i=1}^{n} \beta_i X_{it} + \sum_{j=1}^{k} \gamma_j \bar{X}_{jt} + \delta \text{InitialHealth}_t + \varepsilon_{it} + u_i$$

The dependent variable will be one of three measures for each individual aged 18 years and over in the HILDA at time t ($\text{Outcome}_{i,t}$). *DwellCond* are three dummy variables representing, "good," "average," and "poor–derelict" dwelling conditions (vs. "good–excellent" condition as the base-case)—the explanatory variables of specific interest. X_i are the set of control variables (e.g., age and marital status). To allow for potential correlation between the individual effects and explanatory variables, which may cause bias and inconsistency in the estimates, the Mundlak augmentation is applied: $\bar{X}_j$ are the set of Mundlak means (of time-variant explanatory variables) (Baltagi, 2003; Mundlak, 1978). Following Heckman (1981), information contained in Wave 1 of HILDA is used to derive a predicted value of initial health, which is included as an explanatory variable to account for the "initial condition" issue (*InitialHealth*).

Panel models are useful for this type of analysis as they can account for unobserved heterogeneity in the data (i.e., the unobserved individual differences typical in any group of people which, if ignored, lead to unreliable model results), a perennial problem in cross-sectional models. Nonetheless, the advantages of longitudinal panel methods are not costless—issues raised include state dependence (or time dependence, e.g., past status influences current status) and initial condition (i.e., those who are in poor–derelict dwellings in the first year of the survey may be a non-random sample of the population). We control for both these factors in the models. Error is assumed to be composed of two elements, u_i represents the unobserved individual specific heterogeneity, and ε_{it} the individual time-specific zero-mean random errors. We use Stata 13.1 for all econometric analysis.

The hidden fraction—description and prevalence

Dwellings

Table 1 summarises the data for housing condition. The great majority of the sample resided in dwellings classified as being in good–excellent condition (70%); a quarter in dwellings classified as being in average condition; and just below 5% lived in dwellings classified as being in poor–derelict condition (the pattern varied little over time, *not shown*). When weighted, we estimate that this proportion translates to almost 1 million Australian households living in dwellings classified as poor–derelict in 2001. We further note that within this group, more than 100,000 individuals were residing in dwellings that were rated as very poor–derelict. This simple prevalence finding is of key importance, indicating the existence of a significant (and currently unexplored) population of individuals living in poor condition dwellings in Australia.

Table 2 shows evidence of a strong statistical relationship between dwelling conditions and tenure ($p < 0.001$). Comparing the condition of owned, privately rented, and publicly rented dwellings revealed a clear gradient. Individuals who reside in owned dwellings were much more likely to be in good–excellent condition dwellings (77%), private renters were likely to live (56%), and almost 42% of public tenants lived in dwellings rated as good–

Table 1. Estimated population frequencies (persons, %).

Housing condition	Across wave average
Poor–Derelict	1,093,600
%	4.90
Average	5,564,400
%	24.93
Good–Excellent	15,662,000
%	70.17
Total	22,320,000
%	100

Notes: 2011 population estimates are obtained by application of HILDA survey weights.

Table 2. Estimated population frequencies, dwelling, and tenure (persons, %).

Dwelling condition	Owner/mortgage	Rent private	Rent public
Poor-Derelict	518,528	450,871	194,012
%	3.14	9.46	18.65
Average	3,243,279	1,662,409	413,719
%	19.64	34.88	39.77
Good-Excellent	12,751,832	2,652,801	432,548
%	77.22	55.66	41.58
Total	16,513,639	4,766,081	1,040,280

Notes: 2011 population estimates are obtained by application of HILDA survey weights.

excellent. This gradient was reversed for poor–derelict condition dwellings. In this analysis, almost one in five public renters (19%) lived in poor–derelict quality dwellings, six times more prevalent than the same rate among home-owners, where just 3% lived in poor–derelict condition dwellings.

Characteristics of the hidden fraction

Overall, the population resident in poorer quality dwellings is shown in this analysis to be distinct from the majority of Australians who live in dwellings classified as good–excellent. As summarized in Table 3, younger people, people with disabilities and ill health, those with low incomes, those without full-time (or any) employment, and Indigenous people are all over-represented in poorer quality dwellings.

We found a statistically significant ($p < 0.001$) relationship between dwelling condition and age distribution. Overall, younger individuals were more likely than older individuals to reside in poor quality dwellings. A small percentage of older persons lived in dwellings classified as poor–derelict (3.5%) and a much larger 77% lived in dwellings classified as good–excellent. In comparison, amongst the youngest age cohort (15 to 24 years), 6.4% lived in poor–derelict dwellings, and just 66% resided in dwellings whose condition was rated as good–excellent.

Individuals with a disability or long-term health condition were almost twice as likely as the population with no disabilities or long-term health conditions to live in very poor condition housing. Similarly, people with a disability were more likely to live in housing rated as average and less likely to live in housing rated as good–excellent. As show in Table 3, just over 26% of the population in poor–derelict dwellings had a disability or long-term health condition, and a much smaller proportion (19%) were resident in better quality, good–excellent dwellings ($p = 0.000$).

Unsurprisingly, there was a strong relationship between income decile and dwelling condition ($p = 0.000$). Individuals with higher incomes were more likely to live in better condition dwellings. A small proportion of high-income people lived in dwellings that were ranked in the survey as poor–derelict quality dwellings, and the majority of low-income people lived in very good–excellent quality dwellings. It is only at income levels beyond the third

Table 3. Summary population characteristics.

	Dwelling condition		
	Poor–Derelict	Average	Good–Excellent
Age			
15–24	22	20	16
25–34	20	20	16
35–44	20	21	20
45–54	16	16	18
55–64	11	11	14
65+	11	12	16
Proportion with long term disability/health condition	26	22	19
Proportion lowest 40% income distribution	62	47	36
Labor force/Employment status			
Not in labor force	39	33	34
Unemployed	9	5	3
FT employed	32	40	41
PT employed	20	22	239
Self-rated general health			
Very good/excellent	39	44	50
Good	35	36	37
Fair/poor	26	19	16
Marital status			
Married/de facto	47	55	66
Separated/divorced	14	12	8
Widowed	4	5	5
Never married	35	28	21
Distribution of Indigenous persons	17	36	47
Distribution of non-Indigenous persons	5	24	71

decile that there appeared to be a strong relationship between income and dwelling condition. Overall, as shown in Table 3, more than 60% of individuals who resided in poor–derelict quality dwellings had low household incomes, and a much smaller 36% of the population residing in good–excellent quality dwellings had low incomes.

Those residing in poor–derelict dwellings were substantially more likely to be unemployed (8.5% compared to 2.9%) or not in the labor force (39% compared to 34%), and were much less likely to hold full time employment (32% compared to 41%), than those residing in dwellings rated as good–excellent ($p = 0.000$).

There was a clear difference in the population profiles across the three housing condition types ($p = 0.000$). Married/de facto individuals dominated (66%) the population who resided in housing described as good–excellent, followed by the never married population (21%). This pattern was reversed in the dwelling stock described as poor–derelict, where 35% were never married, and just 47% were married/de facto. Both young and old households appeared to occupy the worst housing, but not having married was clearly a risk factor. This finding aligns with previous research on housing careers (Beer & Faulkner, 2011), showing that marriage and the arrival of children has a long-term stabilizing impact on housing circumstances.

One of the most extreme population variations involved Indigenous persons ($p = 0.000$); strikingly, less than half of Indigenous persons resided in dwellings classified as good–excellent, compared to 71% in the non-Indigenous population. Indigenous individuals were three times more likely than non-Indigenous individuals to reside in poor–derelict dwellings. Relatively small numbers of Indigenous individuals were included in the sample ($n = 1{,}304$), representing only 1.4% (which is less than the 2.5% in the Australian population). Further, missing data and undercounting of Indigenous people is documented for this dataset (see Melbourne Institute of Applied Economic and Social Research, 2013), which is related to the difficulties associated with the difficulties surveying those who live in very remote areas and insecure or temporary accommodation. Thus, these findings are indicative of even greater dwelling condition inequity, which would be evident in a sample that more fully captured Indigenous persons, highlighting the need for dedicated and more detailed further research.

Estimating the effect of poor dwelling condition on health

In this second part of the article, we examine the influence of dwelling condition on various aspects of individual health. Coefficient estimates from three multivariate panel regression models for the explanatory variable (dwelling condition) are summarized in Table 4. The three dependent variables are the SF36-based measures of mental health, physical health, and general health, each are represented on a 1–100 scale. The models are controlled for age, marital status, labor force status, Indigenous and migrant status, residential location, and gender. For each measure, we find strong indication of an association ($p = 0.000$).

The results of these models indicate that (compared to similar persons living in very good–excellent condition dwellings and after controlling for the person characteristics described previously), individuals who lived in

Table 4. Regression coefficients for models of health outcomes.

Dwelling condition	Health outcomes		
(Reference category: Excellent–Very Good)	Mental	Physical	General
Good	−0.096	−0.394*	−0.678***
Average	−0.27	−0.709***	−0.670**
Poor-Derelict	−0.860**	−1.346***	−1.487***
Sample	29873	29323	29311

Notes: (a) Random effects panel regression model with Mundlak method to control for correlation between individual effects and attributes. (b) Slight variations in sample are due to differing missing patterns. (c) Control variables are: age (5 categories vs. base age 15–24), marital status (5 categories vs. base married), security of tenure (2 categories vs. base public rental), labor force status (5 categories), region of location (city vs. remote, inner regional, outer regional), Indigenous, migrant (vs. non-migrant), urban (vs. rural) and male (vs. female).

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

poor–derelict condition dwellings had lower self-assessed general health. This difference in general health was small to moderate (−1.49), and statistically significant ($p = 0.001$). Those individuals living in dwellings rated as good or average showed a similar but smaller effect on general health.

The results for the physical health outcomes model were similar but showed a more linear pattern. The model suggested that compared to individuals living in dwellings rated as excellent–very good, people who lived in poor–derelict dwellings had lower self-assessed health (−1.35, $p = 0.001$). There was a small (but statistically significant) difference for residents living in good or average dwellings when compared to those in excellent–very good accommodation. A similar pattern was seen in the self-assessed mental health model but at a reduced scale and only statistically significant when the mental health of those in poor–derelict dwellings was compared to those in excellent–very good rated dwellings.

Discussion

This article represents one of the few contemporary analyses of housing condition prevalence and effects in Australia. Although it is preliminary work based upon a representative secondary dataset, the article clearly justifies the need for better quality data and further work in this neglected area. The article establishes the existence of housing conditions as a problem that is unevenly distributed within the Australian population, sizeable in its prevalence, and significant in its effect on individual health. The research aimed to test the hypothesis that, despite there being little population-level evidence of direct health effects of housing conditions in Australia, more fine-grained analysis may reveal a "hidden fraction" cohort of individuals who occupy dwellings that are health harming. Our analysis supports this hypothesis, finding a sizeable "hidden fraction" with distinct characteristics and an overall high level of existing disadvantage.

There has been a long-standing debate in Australia about the quality of housing stock and the apparent benign impact it exerts of the health of Australians (Waters, 2001), but our article suggests that this dominant interpretation does not is not fully representative. Previous research has not identified an influence of housing conditions on health, which may reflect limited analytical techniques (e.g., single point in time cross-sectional estimation cannot identify intra-individual changes and effects) or lack of appropriate data. This analysis has provided clear evidence of a substantial stock of poor quality housing in Australia. The scale of poor housing in Australia was surprising and has substantial policy implications and social importance. Our analysis suggests that almost one million Australians live in housing regarded as being in poor condition, and within this group, almost 100,000 Australians reside in dwellings rated as very

poor or derelict. The "hidden fraction" is, therefore, larger than we anticipated. Importantly, these Australians possess the double disadvantage of living in poor quality housing within a nation that does not adequately acknowledge the existence and impact of poor quality housing stock on the health of its residents.

The second major contribution of this article is to describe the distinct characteristics of this hidden fraction of the population. Young people, people with long-term health conditions and disabilities, those in low-income households, the unemployed and underemployed, and Indigenous Australians were all over-represented in the poor condition housing stock. Importantly, these populations are characterized by existing disadvantage and (most probably) greater need for housing, which improves or supports their health and well-being. Those with the poorest health or with a disability were shown to have an above average likelihood of also inhabiting housing that may further contribute to their poor health. This population is at the vulnerable end of many well-known social, economic, and health gradients. The very high proportion of Indigenous persons living in poor condition dwellings was a particular concern. Although the problems of Indigenous housing have been acknowledged by many researchers (for example Bailie & Runcie, 2001; Torzillo et al., 2008), the stark differences to the non-Indigenous population are compelling. Our analysis indicated that less than half of the Indigenous population (47%) lived in high quality dwellings and were more than three times more likely than the broader Australian population to be living in derelict dwellings. We estimate that this proportion equates to 56,000 Indigenous people in the Australian population in 2011 who were at risk of the negative impacts associated with poor quality housing.

The third major conclusion from this analysis is that poor condition housing appears to have a measureable and statistically significant impact on self-assessed mental, physical, and general health. This effect remained after population characteristics were controlled. Our study has established an important link that counters the established view in Australia that there is little population-level evidence of a health effect of housing conditions (for the non-Indigenous population). The size of this health effect is largest (and highly statistically significant) for the roughly one million Australians who live in the very worst housing circumstances.

Overall, this article identifies and seeks to address a gap in the evidence base related to the extent of poor quality housing in Australia and its impact on general health. There is a relatively sizeable population—a hidden fraction—who live in poor condition dwellings, and there are measureable negative health effects related to this disadvantage. Our findings point to the need to focus attention on housing conditions through an improved understanding of the means by which residential environments may positively and negatively affect health.

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