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DISCUSSION PAPER

Overcrowding and Indigenous Health in Australia

Alison Booth* and Nick Carroll*

*Economics Program, Research School of Social Sciences, Australian National University, ACT 0200 Australia

ABSTRACT

We use unique survey data from the 2001 National Health Survey to examine the association between overcrowding and the self-assessed health of Indigenous and non-Indigenous Australians. Our goal is to determine whether or not overcrowding explains why the Indigenous population has worse health than the non-Indigenous population. We find that, after we control for a number of factors, overcrowding of adults (i) appears to be associated with worse health and (ii) explains approximately 30% of the health gap between the Indigenous population living in remote areas and the non-Indigenous population.

1. Introduction

Overcrowded housing can affect health through a variety of channels. For example, if housing conditions are overcrowded, there may be inadequate access to ablution, cleaning and cooking facilities and subsequently a more rapid transmission of infectious diseases and a higher probability of reporting poor health. Overcrowding might also induce psychological stress that could lead to verbal and physical abuse and increase the probability of being in poor health. On the other hand, the presence of many people in a household may imply less social isolation and perhaps a reduction in stress.

In the literature there is evidence of a contemporaneous relationship between housing and health and also some evidence of poor housing experience in childhood affecting adult health (see UK ODPM, 2004 and references therein; Dunn, 2002; and MacIntyre et al, 2003). In Australia, Waters (2001) finds weak evidence of a link between overcrowding and poor self-assessed health using the 1995 National Health Survey.

Housing is of particular interest because it can be affected by government policy in a variety of ways. Policy options include the direct provision of housing, accommodation supplements or rent vouchers, and less directly through the application of minimum building standards.

There are many alternative definitions of overcrowding.[1] In this paper we focus on the relationship between people and rooms, and self-assessed health. A problem with many measures of overcrowding is their assumption that overcrowding is dichotomous rather than continuous. Thus overcrowding is assumed to affect health once an individual

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[1] While number of people per room is a popular measure of overcrowding, an alternative is a measure of sufficiency of people per room. The Canadian National Occupancy Standard for housing assesses the bedroom requirements of a household by specifying that: there should be no more than 2 persons per bedroom; children less than 5 years of age of different sexes may reasonably share a bedroom; children 5 years of age or older of opposite sex should have separate bedrooms; children less than 18 years of age and of the same sex may reasonably share a bedroom; and single household members 18 years or over should have a separate bedroom, as should parents or couples.

crosses a certain threshold and this threshold is inevitably arbitrary. This paper experiments with alternative assumptions and in particular investigates if overcrowding has a non-linear effect on health.

Booth and Carroll (2005) and Cooper (2002) examine the degree to which socio-economic factors explain the large difference in health between the populations of different ethnicities and races. They found that socio-economic factors – especially those related to income prospects - explain between one third and one half of the observed health differences between the populations.

The present paper extends Booth and Carroll (2005) and Cooper (2002) by examining whether or not overcrowding explains an additional part of the health gap. The examination of whether overcrowding explains the gap in health between the Indigenous and non-Indigenous populations is a unique feature of this research. Our two main research questions are: first, is overcrowding associated with worse health? And, secondly, to what extent does the greater prevalence of overcrowding among Indigenous Australians explain the Indigenous and non-Indigenous health gap?

We find evidence of a relationship between overcrowding (particularly of adults) and self-rated health and evidence that housing variables explain part of the health gap between the Indigenous population living in remote areas and the non-Indigenous population. We also find that using a more flexible functional form relating to overcrowding (allowing number of rooms, adults and children to enter separately, rather than having a dichotomous overcrowding variable) is preferred.

2. Data and Methods

Our data source is the Australian Bureau of Statistics' 2001 National Health Survey (NHS). This survey is unique in over-sampling the Indigenous population and women. It

also contains a remarkably rich set of information on health status, use of health services, health-related aspects of respondents' lives, socio-economic factors, and demographic attributes. The principal drawback of the survey is that it is cross-sectional, meaning that our estimates should be interpreted as correlations rather than as establishing causality.

When surveying the Indigenous population, the NHS interviewers were usually accompanied by local Indigenous facilitators. The definition of Indigenous status in the NHS is self-reported. Of course, individuals answering affirmatively to this question may differ in their ties to specific Indigenous and non-Indigenous cultures, main language spoken at home, living arrangements and ancestral links. Therefore in our analysis we disaggregated Indigenous respondents by whether they live in remote or non-remote areas.

Sampling was done at the household level and 1 person in the household aged 18 years and over in each dwelling was selected and interviewed about their health.[2] The complete dataset contains 21,020 with valid health status data. While the 2001 National Health Survey does not have many measures of housing quality, it does provide some information on the number of people and the number of bedrooms in the dwelling.[3]

The primary health variable used in our analysis is self-reported health, based on responses to the question: "In general would you say that your health is Excellent, Very Good, Good, Fair or Poor?". From the responses to this question we construct a categorical variable for self-assessed health, taking the value 1=poor, 2=fair; 3=good; 4=very good; 5=excellent. This categorical variable is used as the dependent variable in our ordered logit specifications. We estimate a simple ordered logit model of the

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[2] This was a usual resident aged 18 years or more whose birthday was closest after the date of interview.
[3] Number of persons in the household is based on the Household Form, where individuals are required to give the age, sex and name of each of the people that usually live in the household. The number of bedrooms is based on the question: "How many bedrooms are there in this dwelling?". The number of bedrooms in the household is top-coded at 4. The number of people in the household is top-coded at 6 for the non-Indigenous population and 10 for the Indigenous population.

determinants of self-assessed health status, in which we assume that there is an underlying latent variable y_i^*, which relates to the observed dependent variable y_i as follows:

$$y_i^* = x_i'\beta + \varepsilon_i \tag{1}$$

$$y_i = j \quad \text{if} \ \gamma_{j-1} < y_i^* \leq \gamma_j \tag{2}$$

Thus the probability that the observed dependent variable equals j is the probability that the latent variable y_i^* is between the boundaries γ_{j-1} and γ_j (where the γs are unknown parameters that are estimated jointly with β). For the ordered logit model, we assume that ε_i conforms to the logistic distribution.

3. Descriptive Statistics

Table 1 reports some descriptive statistics from the National Health Survey, based on a sample of all individuals aged 18 years and over. It shows that the Indigenous population, particularly those living in remote areas, has more people per household and a greater person to room ratio than the non-Indigenous population.[4] In the table, we have shown a common top-coding for the number of people in the household, at 6 or more people. While less than 6% of the non-Indigenous population live in households with 6 or more people, over 10% of the non-remote Indigenous and over 45% of the remote Indigenous populations live in households with more than 6 people. However, the Indigenous and non-Indigenous populations live in dwellings with a similar number of bedrooms.

Now consider the person to room ratio, given in the bottom panel of Table 1. More than 35% of the Indigenous population living in remote areas have more than 1 person per room, compared to less than 10% of the population living in non-remote

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[4] While the 2001 NHS sampling frame included Indigenous population living in remote areas, it excluded the non-Indigenous population living in remote areas.

areas.[5] Nearly 2% of Indigenous females living in remote areas live in a dwelling with more than 2 people per room, and nearly 4% of Indigenous males living in remote areas live in a dwelling with more than 2 people per room. The Indigenous population living in non-remote areas is more likely to have a higher crowding level than the non-Indigenous population.

Top-coding is an issue as about 5% of the non-Indigenous population has a top-coded person number, while close to 30% of the Indigenous population has a top-coded person number. This provides evidence that the Indigenous population is more likely to live in larger households (approximately 20% of the Indigenous population lives in households with 6 or more people and 4 or more bedrooms).

Table 1: People, bedrooms and person to room ratio by indigenous status and sex

	Males			Females		
		Indigenous		Non	Indigenous	
	Non indigenous	Non remote	remote	indigenous	non remote	Remote
Number of bedrooms + 1 (B+1)						
1–2	3.0	4.6	6.9	2.7	2.4	4.3
3	15.7	18.7	10.5	16.2	14.9	13.3
4	49.9	51.7	57.2	50.1	62.0	50.9
5+	31.5	25.0	25.4	31.0	20.7	31.5
Number of people P						
1	11.9	13.3	7.4	12.8	9.0	3.3
2	32.9	22.1	11.5	32.9	27.8	8.8
3 – 5	50.0	54.3	32.7	48.5	48.2	34.8
6+	5.1	10.3	48.3	5.8	15.0	53.0
Person to room ratio P/(B+1)						
< = 0.5	35.6	25.0	14.6	36.9	29.3	9.2
< = 1	54.3	60.7	25.3	53.0	48.2	25.6
< = 2	6.6	8.7	36.3	5.8	15.0	44.3
> 2	0.0	0.0	3.6	0.0	0.1	1.8
top-code	3.5	5.7	20.2	4.3	7.3	19.1

Notes:

a.　　　Person to room ratio = P/(B+1), where P denotes the number of people in the dwelling and B is the number of bedrooms. The denominator is (B+1) to take into account bedsitters. Note that P is top-coded in the table at 6 and B is top-coded at 4.

b.　　　Where both people and bedrooms are top-coded, the label is 'top-coded'.

c.　　　While the 2001 NHS sampling frame included the Indigenous population living in remote areas, it excluded the non-Indigenous population living in remote areas.

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[5] Where the number of rooms in house is defined as the number of bedrooms + 1 to include bed-sitters.

Table 2 reports cross-tabulations of poor health by over-crowding. Surprisingly, the raw data show that a greater proportion of those people living in over-crowded dwellings - those with a ratio of $[P/(B+1)] > 2$ - report good health than do those in non-overcrowded dwellings (85.9% compared to 81.9%).

Table 2: Overcrowding by good health

	no overcrowding	over-crowded
good health	81.9	85.9
poor health	18.1	14.1

notes: ratio is calculated as in table 1. Overcrowding is where ratio>2. Poor health is self-assessed health is either fair or poor, good health is good, very good, or excellent

There are a number of reasons that we may observe that over-crowding is *associated* with good health, even though over-crowding *causes* worse health. First, people in lone households may have worse health (because of either selection or a causal mechanism) and they will necessarily have a ratio of 1 or lower. Secondly, the top-coding of the National Health Survey data could be an issue and we may be ignoring much of the most serious over-crowding. Thirdly, over-crowding of adults may be more serious than overcrowding caused by children. Fourthly, it may be that people living in crowded dwellings self-rate their health more positively, but their health may be worse on objective measures. These issues are addressed in the regression results below.[6]

4. Results

The first 3 specifications in Table 3 are ordered logits in which the dependent variable is self-assessed health (with positive coefficients meaning that there is an increased probability of being in a better health category). The final specification is a binary logit

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[6] A final issue not possible to address with the 2001 National Health Survey is that overcrowding in childhood may affect both childhood and adulthood health. We abstract from this because data are only available on adult overcrowding and adult health. We examined whether the top-coding was an issue in results not presented in this paper. Using the fact that the Indigenous population had a higher top-code on number of people in the dwelling, it was found that allowing for a different top-code for the Indigenous population changed the results little.

with the dependent variable being whether hospitalised over the past year (with positive coefficients meaning that there is an increased probability of being hospitalised over the past year). Appendix 1 gives descriptions and means of the main variables used.

Table 3: Regression results

	(1) simple overcrowd	(2) numbers in house	(3) adults / kids	(4) hospital rate
non-remote Indigenous	-0.36**	-0.38**	-0.37**	0.45**
remote Indigenous	-0.14	-0.24**	-0.24**	0.56**
overcrowded	0.04			
room1		0.24	0.23	-0.09
room3		0.18**	0.18*	-0.20
room4		0.24**	0.24**	-0.16
room5		0.39**	0.39**	-0.24*
person2		0.04		-0.05
person3		0.10		0.10
person4_5		0.15		-0.01
person6_		0.10		0.13
adult2			-0.05	
adult3			-0.12	
adult4			-0.05	
child1			0.05	
child2			0.10	
child3			0.19**	
nchild4_			0.08	
ichild4_5			-0.10	
ichild6_7			0.04	
ichild8_			0.02	
demographics	Yes	Yes	Yes	Yes
socio-econom.	Yes	Yes	Yes	Yes
observations	15419	21013	21013	21013
Pseudo R2	0.12	0.12	0.12	0.03

Notes: specifications (1)-(3) estimated using ordered logit with self assessed health as the dependent variable. In specification (4) the dependent variable takes a value of 1 if hospitalised over the past year.
base category: non-Indigenous households, in 1 bedroom dwelling, with 1 person in household (specs 2,&4), 1 adult and 0 children (spec 3) . Only people aged 18 years and over are included in these estimations. Thus we are only examining the impact of adult over-crowding on adult health.
The demographic variables are: age, sex, living arrangement and marital status. The socio-economic status variables are: income, source of income, years of education, hours of work and employment status.

Specification (1) confirms the results from the descriptive statistics above. That is, overcrowding appears to be weakly associated with better self-rated health and this result holds even when we control for lone person households and other characteristics of household composition (the result is not significant at the 5% level). Thus the positive

relationship between over-crowding and health does not appear to be being driven solely by household composition, demographics, or socio-economic status. Note however the restrictive nature of this specification, which arises from an arbitrary selection of an overcrowding cutoff of >2 and the restrictive functional form implied by this ratio.[7]

In specification (2) the overcrowding ratio is broken down into number of people and number of bedrooms. Firstly, living in a dwelling larger than a 2-bedroom dwelling is associated with better health at the 1% level and living in a dwelling with 4 or more bedrooms (room5) is associated with better health than living in a smaller dwelling (see specification (2)).[8]

While having more bedrooms (for a given number of people) is associated with better self-rated health (evidence for an effect of over-crowding), an increased number of people in the household is also associated with better self-rated health (leading to the positive effect of overcrowding in specification (1)). In particular, living in a household with 4-5 people is associated with the better health (person4_5) than living in a smaller household, although the result is not statistically significant.

Specification (3) disaggregates people in the household down into adults and children, where adults are defined as anyone 18 years and over. In this specification a greater number of children is positively associated with greater adult self-rated health (the coefficient on 3 children is 0.19), whereas a greater number of adults is negatively associated with adult self-rated health (the coefficient on 3 adults in the household is –0.12). The positive effect of number of bedrooms on health remains.

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[7] The choice of 2 people per bedroom was chosen because the Canadian National Occupancy Standard for Housing assesses that there should be no more than 2 persons per bedroom. Alternative cut-points at 0.5, 1.0, 1.5 were also estimated separately and all had positive signs and were insignificant at the 10% level.

[8] It should be noted that we are controlling for a number of factors that are related to wealth (which in turn may be related to both dwelling size and health). These factors include education, income, income source and employment status.

This result suggests that using the raw number of people may give a misleading impression of the impact of over-crowding on adult health and that the number of adults and children on overcrowding should be examined separately. Overall, the results from specification (3) suggest that over-crowding of adults is weakly associated with worse self-rated health.

Specification (4) confirms the earlier results and shows that people living in larger households are more likely to be hospitalised, whereas there appears little relationship between number of people and hospitalisation. Likewise, a further specification was run on the probability of having a mental disorder (not shown). It was found that living in a dwelling with more bedrooms or with fewer people was associated with a slightly lower probability of reporting emotional problems.

Finally, we compare the estimated coefficients to Indigenous status (both remote and non-remote) across specifications of the determinants of self-assessed health. Such a comparison shows the degree to which the health gap can be explained by the variables available in our data set. The results are presented in Table 4.

Interestingly, the coefficient on *remote* Indigenous drops from -0.34 when housing information is not included (but demographic and socio-economic characteristics are included) to between –0.14 to –0.24 when the housing information is also included. This suggests that dwelling characteristics do explain some portion of the gap in health between the remote Indigenous and the non-Indigenous populations. However, when the housing variables are included there is little change in the coefficient on non-remote Indigenous (it remains close to the –0.40 recorded in the estimation without over-crowding information).

Table 4: The effects between housing and other socio-economic status variables

	Simple	SES	housing	SES + housing
Indigenous – non-remote	-0.73**	-0.40**	-0.67**	-0.37**
Indigenous - remote	-0.80**	-0.34**	-0.63**	-0.24**
Demographic variables	Yes	Yes	Yes	Yes
Socio-economic variables	No	Yes	No	Yes
Housing variables	No	No	Yes	Yes

Notes: ** significant at the 1% level. * significant at the 5% level.
Housing variables from specification (3) of table 3. The demographic variables are: age, sex and marital status. The socio-economic status variables are: income, source of income, years of education, hours of work and employment status.

5. Conclusion

Our results show that the remote Indigenous population has a greater incidence of over-crowding than the non-remote population. The simple descriptive statistics and initial multivariate analysis showed that over-crowding had little relationship to health status. However, there was evidence that living in larger dwellings (holding the number of people constant) and that living with fewer adults (for a given number of rooms) was associated with better health. In addition, dwelling characteristics explained approximately one third of the remaining gap in health between the Indigenous population living in *remote* areas and the non-Indigenous population.

The evidence for a link between housing and health suggests that housing policy may have a role to play in lifting health outcomes, especially for the *remote* Indigenous community. For this group, a large proportion of the average gap was explained by housing variables. On the other hand, for the *non-remote* Indigenous population, the education and income variables are more important in explaining the health gap than the housing variables, as Table 4 indicated.

These results suggest that targeting may be a policy option. To lift Indigenous health outcomes, increased housing resources might be targeted at remote Indigenous communities, while improving education and income prospects appears to be the more pressing issue for the non-remote Indigenous population.

References

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Appendix 1: Variable names and descriptions

Variable	Description	Means
non-remote Indigenous	=1 if Aboriginal or Torres strait islander in non- remote area, 0 otherwise	0.06
remote Indigenous	=1 if Aboriginal or Torres strait islander in remote area,	0.04
overcrowded	=1 if number of people/ number of bedrooms+1>2, 0 otherwise	0.01
room1	=1 if bed-sitter dwelling, 0 otherwise	0.01
room3	=1 if 2 bedroom dwelling, 0 otherwise	0.18
room4	=1 if 3 bedroom dwelling, 0 otherwise	0.51
room5	=1 if 4+ bedroom dwelling, 0 otherwise	0.27
person2	=1 if 2 person household, 0 otherwise	0.31
person3	=1 if 3 person household, 0 otherwise	0.16
person4_5	=1 if 4-5 person household, 0 otherwise	0.25
person6_	=1 if 6+ person household, 0 otherwise	0.05
adult2	=1 if 2 adults in household, 0 otherwise	0.54
adult3	=1 if 3 adults in household, 0 otherwise	0.12
adult4	=1 if 4+ adults in household, 0 otherwise	0.06
child1	=1 if 1 child in household, 0 otherwise	0.16
child2	=1 if 2 children in household, 0 otherwise	0.16
child3	=1 if 3 children in household, 0 otherwise	0.07
nchild4_	=1 if 4+ children in non-Indigenous household, 0 otherwise	0.02
ichild4_5	=1 if 4-5 children in Indigenous household, 0 otherwise	0.01
ichild6_7	=1 if 6-7 children in Indigenous household, 0 otherwise	<0.01
ichild8_	=1 if 8+ children in Indigenous household, 0 otherwise	<0.01