

A horizontal teal bar with a white circular icon on the left side.

# Finding the crowding index that works best for New Zealand

Applying different crowding indexes to Census of  
Population and Dwellings data for 1986–2006

Statistics New Zealand Working Paper No 11–04

RK Goodyear, A Fabian, & J Hay



#### **Crown copyright ©**

This work is licensed under the Creative Commons Attribution 3.0 New Zealand licence. You are free to copy, distribute, and adapt the work, as long as you attribute the work to Statistics NZ and abide by the other licence terms. Please note you may not use any departmental or governmental emblem, logo, or coat of arms in any way that infringes any provision of the Flags, Emblems, and Names Protection Act 1981. Use the wording 'Statistics New Zealand' in your attribution, not the Statistics NZ logo.

#### **Liability**

While all care and diligence has been used in processing, analysing, and extracting data and information in this publication, Statistics New Zealand gives no warranty it is error free and will not be liable for any loss or damage suffered by the use directly, or indirectly, of the information in this publication.

#### **Citation**

Goodyear, RK, Fabian, A, & Hay, J (2011). *Finding the crowding index that works best for New Zealand* (Statistics New Zealand Working Paper No 11–04). Wellington: Statistics New Zealand

ISSN 1179-934X (online)

ISBN 978-0-478-37741-5 (online)

#### **Published in January 2012 by**

Statistics New Zealand  
Tatauranga Aotearoa  
Wellington, New Zealand

[info@stats.govt.nz](mailto:info@stats.govt.nz)

Phone toll-free 0508 525 525

Phone international +64 4 931 4610

[rosemary.goodyear@stats.govt.nz](mailto:rosemary.goodyear@stats.govt.nz)

[www.stats.govt.nz](http://www.stats.govt.nz)

# Contents

<b>Abstract .....</b>	<b>6</b>
<b>1 Introduction .....</b>	<b>7</b>
1.1 Background on crowding indexes .....	7
1.2 Measures investigated in this paper.....	8
<b>2 Literature review on crowding .....</b>	<b>11</b>
2.1 Why crowding is an issue .....	11
2.2 Research on which crowding indexes are more effective.....	12
2.3 Applying crowding measures across cultures .....	13
<b>3 Data and methods.....</b>	<b>17</b>
3.1 Data used to investigate crowding .....	17
3.2 Methods .....	18
<b>4 Results .....</b>	<b>20</b>
4.1 Data quality.....	20
4.2 Data: Structure of results.....	22
4.3 Numbers and proportions of crowded households .....	25
4.4 Characteristics of crowded households .....	28
<b>5 Identifying the index that fits best with New Zealand’s cultural and social norms</b>	<b>39</b>
5.1 Distribution of crowding by ethnicity showed little variation by index .....	39
5.2 How the indexes affect the age distribution of crowding.....	42
5.3 How the indexes align with social norms in New Zealand .....	43
<b>6 Discussion.....</b>	<b>45</b>
<b>7 References.....</b>	<b>50</b>
<b>Appendix 1: Census questions and comparability over time .....</b>	<b>54</b>
<b>Appendix 2: Crowding measurements.....</b>	<b>55</b>
<b>Appendix 3: Revised Jensen Scale and Jensen Equivalised Annual Household Income (JEAH) .....</b>	<b>57</b>
<b>Appendix 4: Distribution of crowding by territorial authority .....</b>	<b>58</b>

# List of tables and figures

## Tables by chapter

<b>1 Introduction</b> .....	<b>7</b>
1 Summary of differences between crowding indexes.....	9
2 Categories usually reported in each crowding index .....	10
<b>4 Results</b> .....	<b>20</b>
3 Crowded households under the ACI, by number of bedrooms and number of usual residents .....	22
4 Comparison between CNOS and ACI, 2006 Census .....	27
5 Characteristics of crowded households, 2006 Census .....	28
6 Crowded households and total households, by household composition (condensed).....	30
7 Crowded and severely crowded households, by selected characteristics.....	32
8 Percentage of crowded households by region, 2006 Census .....	35
9 Percentage of crowded households in most- and least-crowded territorial authority areas, 2006 Census.....	36
10 Area units with the highest proportion of crowded households, ranked by CNOS..	37
11 Correlation between severe crowding at area-unit level and ethnicity, by index.....	38
<b>5 Identifying the index that fits best with New Zealand's cultural and social norms</b> .....	<b>39</b>
12 People in crowded households, by ethnicity (total responses).....	40
13 People living in crowded households, by selected single/combination ethnicity .....	41
<b>6 Discussion</b> .....	<b>45</b>
14 Assessment criteria for crowding indexes .....	45

## Figures by chapter

<b>2 Literature review on crowding</b> .....	<b>11</b>
1 Number of bedrooms by tenure of household.....	14
<b>4 Results</b> .....	<b>20</b>
2 Number of other rooms, 1991 to 2006 Censuses .....	20
3 Number of bedrooms, 1991 to 2006 Censuses .....	21
4 Distribution of observations for BBS index, 2006 Census .....	23
5 Distribution of observations for CNOS index, 2006 Census .....	23
6 Distribution of observations for ACI, 2006 Census .....	24
7 Distribution of observations for ECI, 2006 Census .....	24
8 Distribution of index data for BBS and CNOS and ECI, 2006 Census .....	25
9 Percentage of households and people crowded by index, 2006 Census.....	25
10 Comparing crowding indexes, 2006 Census.....	26

11	Crowding in New Zealand households, by index .....	27
12	Median Jensen income for households that were crowded (in one index and not another).....	29
13	Household composition compared, for crowded and total households .....	30
14	Proportion of households that were crowded, by number of dependent children ...	31
15	Space utilisation (using CNOS), by number of dependent children.....	33
16	Median JEAH income by selected crowding categories, 2006 Census.....	33
17	Different measures of household crowding in New Zealand, 2006 Census .....	34
18	Distribution of total crowded households (CNOS) by area unit, 2006 Census.....	36
19	Correlation between percentages of households (that were crowded at area unit level (ACI and CNOS)) .....	38
<b>5</b>	<b>Identifying the index that fits best with New Zealand's cultural and social norms</b>	<b>39</b>
20	Percent of people living in crowded households for all indexes, by ethnic group (level 1) .....	40
21	Proportion of people crowded, by single response ethnicity (level 1) and index.....	41
22	Age distribution (single year), by crowding indexes .....	42
23	Age distribution (single year) for people 22 years and under, by crowding indexes	43

## Abstract

This study aimed to determine which household crowding measure worked best in the New Zealand context.

The issue of crowded households has concerned researchers in New Zealand in recent years, particularly because of the relationship between crowding and ill-health. Research shows that the incidence of close-contact contagious diseases, such as meningitis and bacterial pneumonia, rises sharply in the most-crowded areas.

There is no standard measure of crowding used internationally, but in New Zealand the Canadian National Occupancy Standard (CNOS) is often used as a de-facto standard. However, uncritical use of this standard has generated some controversy. This is particularly in the health sector, largely around the question of the 'cultural appropriateness' of this and other crowding measures.

Different quantitative crowding measures were applied to New Zealand census data. Investigations involved assessing data quality, examining a cultural fit with the New Zealand context, and exploring the results of analysis. Crowded populations were compared to see whether characteristics of people and households, or the geographic distribution of crowding, varied by index. This process involved data analysis and also discussion of crowding concepts with agencies that deal with housing issues.

Results indicate that the type of index used substantially affected the number of households and people identified as living in a crowded household. The percentage of crowded households varied from 2.7 percent (American Crowding Index) to 6.9 percent (Equivalised Crowding Index). This variation shows the importance of understanding the impact that different definitions of crowding can have when enumerating the extent of crowding within a population.

The characteristics of crowded households, however, were broadly similar regardless of the index used. The type of index did not really affect the ethnic or geographical distribution of crowding.

Determining which crowding index was most effective largely depended on two aspects: data quality and cultural fit within New Zealand norms. The Canadian National Occupancy Standard appeared the 'best fit' within the New Zealand context. However, presenting figures for more than one crowding index enables international comparisons to be made.

# 1 Introduction

## 1.1 Background on crowding indexes

No standard measure of crowding is used internationally or in New Zealand. The question of which measure to use is important since different measures generate considerable variation in the numbers defined as crowded. Schluter et al (2007) commented:

If the crowding indices lead to substantially discrepant classifications and prevalence estimates of crowding, then this has important political, housing, and health implications in understanding and developing strategies to combat household crowding and the costs associated with these policies. Adoption of a poor measure may yield bias estimates of the true housing need which may in turn lead to an inappropriate apportionment of energy and funds, and ultimately a failure to efficiently deal with those in the greatest need.

The level of crowding, as measured by a crowding index, indicates the size of the problem (according to that index) and the amount of action required to fix the problem. However, if an index is regarded as irrelevant or inappropriate in the New Zealand context, particularly for Māori and Pacific peoples, the information it generates may be disregarded.

Crowding indexes are generally quantitative measures based on a calculation that involves the number of people in a dwelling and the dwelling size, or a proxy for size such as the number of rooms or bedrooms. Quantitative measures range from simple counts of people and rooms, to more sophisticated models that also take into account household composition and demographic information. Quantitative measures currently used in New Zealand include the Canadian National Occupancy Standard, which is a de-facto standard, and the Equivalised Crowding Index, which was developed in New Zealand by the Ministry of Health. The American Crowding Index/People per room measure has been used in the past and is widely used internationally. The 1947 Housing Regulations in New Zealand include a definition of crowding, based on room size and number of bathrooms required for the number of usual residents, but it cannot be used with existing data sources.

Other international measures include the Occupancy Rating Standard and the British Bedroom Standard, which are used in the United Kingdom. In addition, the World Health Organisation recommends a 'people per floor area' index. In the health field, New Zealand researchers have used a self-recorded perception of crowding.

As well as data quality issues, the appropriateness of these indexes for the cultural and social context in New Zealand is considered. Crowding measures are often criticised on cultural grounds because they involve assumptions about the adequacy of space. Bedroom measures set arbitrary standards about how many people should share a bedroom and at what age they should have their own bedroom. The people per room index, or people per floor area indexes, appear more neutral, but assume that children and adults have similar space requirements, which could be regarded as culturally inaccurate. All indexes impose arbitrary thresholds to define crowding. Self-reported perceptions of crowding involve more internalised assumptions about the use of space and are often regarded as less intrusive since they do not impose dominant cultural norms on a minority group.

## 1.2 Measures investigated in this paper

Of six international measures of crowding investigated, four were applied to the New Zealand census data: Equivalised Crowding Index, Canadian National Occupancy Standard, British Bedroom Standard, and American Crowding Index/People per room. The appendices contain information about other measures investigated for this paper. One-person and couple households cannot be overcrowded according to bedroom measures.

### Equivalised Crowding Index (New Zealand)

In the mid 1990s, the Ministry of Health in New Zealand developed the Equivalised Crowding Index (ECI). This is a ratio of the number of bedrooms needed divided by the number of bedrooms available:

$$\frac{(0.5 * \text{number of children under 10}) + (\text{number of couples}) + (\text{all other people aged 10 and over})}{(\text{number of bedrooms available})}$$

According to the ECI, a value greater than 1 indicates a household is crowded. The Ministry of Education uses this indicator to help calculate a school's decile index, which is used to allocate extra resources on the basis of deprivation.

### Canadian National Occupancy Standard

Under the Canadian National Occupancy Standard (CNOS), a household is said to be crowded if the dwelling requires extra bedrooms in order to meet the following criteria.

- There should be no more than two people per bedroom; parents or couples share a bedroom.
- Children aged less than five years, either of same or opposite sex, may reasonably share a bedroom.
- Children aged less than 18 years, of the same sex, may reasonably share a bedroom.
- A child aged five to 17 years should not share a bedroom with one aged under five years of the opposite sex.
- Single adults aged 18 years and over, and any unpaired children, require a separate bedroom.

The New Zealand Deprivation Index uses CNOS as an indicator of crowding. CNOS is used in Australia and Canada (but not by Statistics Canada) as well as in New Zealand. The Australian Bureau of Statistics (ABS) (2010) uses the CNOS index to measure crowding because "it is considered to conform reasonably to social norms in Australia". The ABS also currently applies this measure for Aboriginal and Torres Strait Islanders despite concerns as to whether "the perception and reality of whether overcrowding is experienced will be influenced by structural and cultural considerations".

### British Bedroom Standard

The British Bedroom Standard (BBS) is similar to the CNOS, but follows different age criteria and is used in the United Kingdom (UK) by the Office for National Statistics. A separate bedroom is allocated to:

- each married or cohabiting couple
- any other person aged 21 years and over

- each pair of adolescents, aged 10 to 20 years, of the same sex
- each pair of children aged under 10 years.

Any unpaired person aged 10 to 20 years is paired, if possible with a child under 10 years of the same sex, or is given a separate bedroom, as is any unpaired child under 10 years.

## American Crowding Index/People per room

The American Crowding Index (ACI)/People per room index (PPR) is used by many countries, including the UK Office of National Statistics, United States Census Bureau, and Statistics Canada. It appears to be the oldest measure of crowding in use. It is defined as the number of people living in a dwelling divided by the number of rooms. According to this index, dwellings with more than 1 person per room are crowded, and those with more than 1.5 people per room are severely crowded. A measure of underutilisation can be added if required (less than 0.5 people per room). As this measure simply compares the number of people and number of rooms, it does not consider additional factors that may affect crowding, such as the age and sex of household members and the need for individual space. The ACI/PPR is generally easier to calculate as it requires fewer variables than the more complex bedroom-based measures.

## Summary of differences between crowding indexes

Table 1 summarises the differences between the crowding indexes used for this paper while Table 2 looks at the range of categories within crowding indexes. Under the ACI a household is considered crowded if there is more than 1 person per room. Under the bedroom indexes it is assumed that there should be no more than two people per bedroom and that couples can share a bedroom. Each index has its own criteria for when it is appropriate for boys and girls to share and the age when a child is entitled to their own room.

**Table 1**

### Summary of differences between crowding indexes

Index	Based on	Uses couple status	Age when pairs of boys and girls can share (years)	Age when pairs of same sex children can share (years)	Age when own room required
ACI/PPR	rooms	no	...	...	...
BBS	bedrooms	yes	under 10	under 21	21+
CNOS	bedrooms	yes	under 5	under 18	18+
ECI	bedrooms	yes	under 10	under 10	10+

**Symbol:** ... not applicable

Two of the measures are calculated as ratios (the ACI/PPR and ECI), while two are difference measures (CNOS and BBS). The ACI/PPR and ECI do not easily translate into bedrooms, or rooms required or spare, since the data is continuous. Therefore any severe crowding or underutilisation measure relies on an arbitrary numerical threshold.

CNOS has the widest range of categories – from severely crowded households to households with two or more spare bedrooms. The BBS index usually includes information about underutilisation, but not about the severity of crowding. ACI usually includes information about severe crowding and in the United States includes information about underutilisation. The ECI has no official category for underutilisation or for severe

crowding. It is possible to programme further categories of crowding or underutilisation for the bedroom indexes but these are not normally reported or included in the official categories.

**Table 2**

**Categories usually reported in each crowding index**

<b>Index</b>	<b>Crowded</b>		<b>Not crowded</b>		
<b>ACI/PPR</b>	Severely crowded	Crowded	Not crowded $\leq 1.0$ person per room		
	$>1.5$ people per room	$>1.0 \leq 1.5$ people per room			
<b>BBS</b>	Overcrowded		Not crowded		
	1 or more extra bedrooms needed		Equal to standard	One above standard	Under-occupied
<b>CNOS</b>	Crowded		Not crowded		
	2 or more extra bedrooms needed	1 extra bedroom needed	No extra bedrooms needed, none spare	One bedroom spare	Two or more bedrooms spare
<b>ECI</b>	Crowded $>1.0$		Not crowded $\leq 1.0$		

## 2 Literature review on crowding

This chapter offers a summary of national and international research on crowding.

### 2.1 Why crowding is an issue

In the early 2000s, there was debate as to whether crowding represented an issue of real or constructed concern. A literature review of crowding indexes in New Zealand (Gray 2001) suggested that insufficient evidence on the harmfulness of crowding meant that it should not be a policy focus.

Myers et al (1996) conclude that “after a century of debate it is still in question whether so-called overcrowding is harmful to the people affected, or merely socially distasteful to outsiders who observe its presence.” Research since Gray’s review has proved more conclusively the links between crowding and poor outcomes, particularly in relation to health. Crowding continues to be of concern to policy makers.

#### **Relationship between crowding and ill-health**

There is a well-documented relationship between crowding and ill-health and evidence that crowding can have a negative effect on other outcomes. Crowding has been linked with poorer physical health, especially rates of infectious disease transmission, poorer mental health, poorer educational outcomes for children, and poorer social outcomes. The evidence for links between crowding and physical health are strongest but there is evidence showing links between household crowding and all these areas of concern.

Links between crowding and infectious disease are fairly strong, with evidence dating back to World War I when links were shown between meningococcal disease and crowding in institutional settings. Both New Zealand and overseas research reinforce the connection between communicable diseases and crowding. Recent New Zealand studies link household crowding with infectious diseases such as meningococcal disease, tuberculosis (TB) and acute rheumatic fever (eg Baker et al, 2001, 2003, 2008). A Motu research paper (2006) noted that communicable diseases increased with the level of household crowding. They found that “for each 10% increase in the proportion of children living in crowded households in a particular census area, the rate of infectious disease admissions increases by 1% (after controlling for income and income inequality).” The paper identified a worrying upward trend in the number of cases of infectious diseases in New Zealand, an issue that has concerned health researchers.

A study published by the Canadian Tuberculosis Committee (2007) observed that an increase of 0.1 people per room (PPR) increased the risk of two or more cases of TB in a community by approximately 40 percent. Crowding is an issue in developing countries particularly, with an OECD (2001) health study explaining “Apart from straining facilities, crowding is in itself an important factor for disease transmission.”

#### **Children at greatest risk from crowding**

Research reveals that children are particularly at risk from living in crowded conditions. In New Zealand (Baker et al, 2001), household crowding was associated with increased risk of meningococcal disease for Auckland children. The authors argued that “Measures to reduce overcrowding could have a marked effect on reducing the incidence of this disease in Auckland children.” Crowding was also associated with TB infection in New Zealand.

Overseas, studies identified crowding and household size as risk factors for Haemophilus influenza infection in children. Research in Norway and Alaska revealed links with respiratory syncytial virus. The link between crowding and ill-health in children highlights the importance of ensuring that crowding is measured appropriately for children. Health issues with household crowding in New Zealand may also be exacerbated by poor

housing quality. Poor ventilation and air circulation compound the spread of disease within a crowded household and reduce the ability of vulnerable people to fight infection.

### **Crowding link with mental health not as clear**

The evidence for crowding affecting mental health and leading to poor social outcomes is not as clear. A review of the literature in the UK (2004) concluded that since mental health studies often depend on small-scale qualitative studies, the effects tend to be smaller and less significant than the links between physical health and crowding.

Research has been contradictory but later studies show some support for links between crowding and mental health.

### **Crowding may affect educational attainment**

There is evidence that crowding can affect children's educational attainment, but again the literature is not extensive or conclusive. Often it is difficult to disentangle crowding as an independent factor because of the effect of other housing-related factors. These limitations are noted in reviews of the literature. Research from the United States, which uses the rich household and longitudinal datasets available there, has found links between household crowding and educational attainment – possibly because of lack of privacy or a quiet space to study, greater sleep disturbance, and stress within the household.

### **Different measures may be needed for different purposes**

Evidence from the United States' studies shows the importance of accurately measuring crowding, to identify high-risk households, but also highlights that different measures of crowding might be required for different purposes. For example, if a researcher wants to examine the link between crowding and educational attainment, a more generous distribution of space may be more appropriate (such as a bedroom for each teenager).

For medical researchers, a tighter definition of crowding may be more appropriate, to identify links between crowding and infectious disease. In contrast, a housing agency might be more concerned with the appropriateness of bedroom allocation by age and sex.

### **Characteristics associated with crowding**

Evidence from literature identifies a range of characteristics associated with crowding that appear fairly consistent across countries. For example, in the United States crowding was much higher among ethnic minorities and the indigenous population. Crowding was also much more prevalent among renting households and low-income households. In Canada and Australia, crowding rates were also much higher among indigenous communities. Crowding was also more common among sole-parent and multi-family households.

## **2.2 Research on which crowding indexes are more effective**

There has been little analysis on which crowding index is most effective in the New Zealand context. Alison Gray's literature review (2001) provided a theoretical critique of some indexes used in New Zealand and concluded there was no 'ideal' index. She commented on the arbitrary nature of all crowding indexes:

These definitions express a judgement about density levels, that is, they set a standard by which society declares crowding beyond a particular density to be unacceptable.

However, her work did not include any empirical research into indexes.

Little work has been done on validating different indexes, except in the health field where there is some support for using the Canadian National Occupancy Standard (CNOS)

index. Crowding is one variable used to create the Deprivation Index produced by the Wellington School of Medicine on behalf of the Ministry of Health. The health researchers responsible for the index included CNOS in 2001, noting it was a more accurate measure of occupancy than a previously used OECD measure.

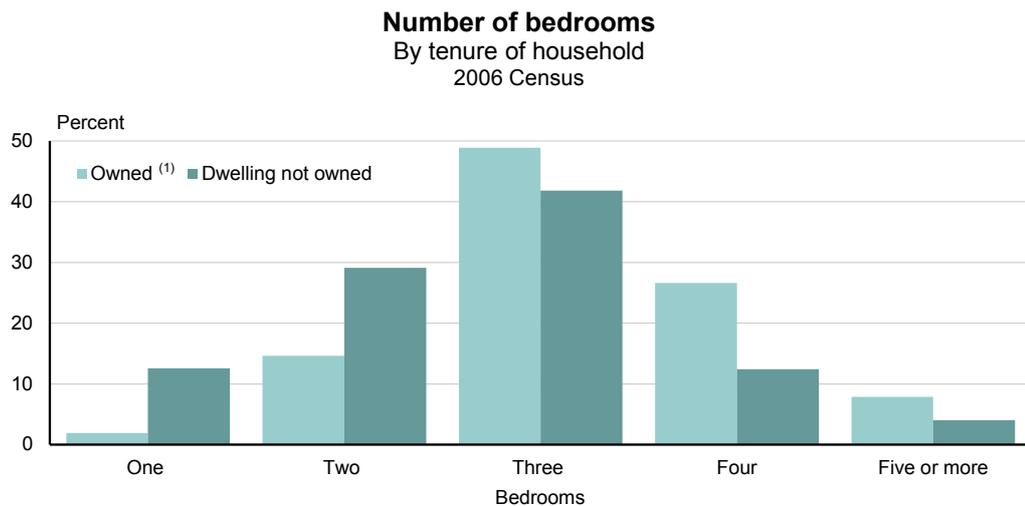
A study published in the *New Zealand Medical Journal*, (Schluter et al, 2007) examined indexes for a study of Pacific households. It concluded that results differed considerably depending on the index used. Schluter et al favoured self-reported perception of crowding over quantitative measures and compared this measure with the three indexes used in this paper. They argued that self-reported perception of crowding showed the strongest correlation with outcome variables, such as housing satisfaction. They compared the results for self-reported perception of crowding with other indexes. The American Crowding Index (ACI) and CNOS showed the highest correlation with self-reported perception of crowding, although the ACI appeared marginally better. The ECI showed the greatest misalignment with self-reported perception of crowding – the authors were surprised by the high levels of crowding recorded under this index. They noted that the ECI identified considerably more households as crowded “almost double self-reported, thus suggesting that this index is overly sensitive for this Pacific population”. Their work raised a common concern that certain indexes (in particular the ECI) might be inappropriate for the Pacific population.

## 2.3 Applying crowding measures across cultures

Some researchers have commented that indexes based on bedrooms might be culturally inappropriate for some ethnic groups. A study into healthy housing in Auckland noted that all crowding indexes were based on assumptions of the dominant culture – there was no research on Māori and Pacific concepts of crowding. It is important to identify factors that might make using a particular crowding index inappropriate in a particular context – such as the physical structure of housing, climatic factors, and cultural attitudes to space utilisation within a household.

### **The physical environment/structure of housing**

In some countries, indexes based on either rooms or bedrooms would not be appropriate if a large single space is used for sleeping, eating, and other household activities. For example, traditional Japanese and Pacific houses use living spaces rather than separate bedrooms for sleeping. The World Health Organisation index (people per floor area) would be more appropriate in these cases. In New Zealand, this type of housing would be unusual. Most New Zealand houses are detached family homes, although newer housing includes a wider range of forms, such as semi-detached, or joined, town houses and apartments. In 2006, 81 percent of private dwellings were defined as separate dwellings. The New Zealand housing stock has traditionally been fairly small-sized and unsuited to large families or households. Rented housing tends to be smaller than owned housing.

**Figure 1**

1. Includes dwellings owned with or without mortgage and dwellings owned by a family trust.

Source: Statistics New Zealand

The issue of rental housing is important since the majority of people living in crowded housing are in dwellings they do not own. Figure 1 shows that owned dwellings were larger than those that were not owned, as measured by number of bedrooms.

As the work of the Healthy Housing programme shows (2009) New Zealand houses tend to be inadequate for extended family living. Work looking at housing form by Housing New Zealand (2002, 2004) also shows that traditional state housing (and probably much private housing) is often unsuitable for Māori and Pacific peoples, both in terms of size, and in physical layout.

The physical environment is also important when evaluating crowding indexes. In New Zealand's damp, temperate climate, people may spend more time indoors than they do in the tropics, which exacerbates the health consequences of crowding. For example, a recent report (Changemakers Refugee forum, 2011) discovered that refugee families suffered health problems after arrival in New Zealand, caused by damp, mouldy, and often overcrowded homes. Organisations such as BRANZ have shown the New Zealand housing stock tends to be poorly insulated and ventilated.

## Cultural attitudes to space utilisation within households

An important part of this paper's research was to discuss the assumptions behind indexes with relevant groups, and examine any relevant literature.

Housing New Zealand's design guides for Māori and Pacific housing are very useful. They give detailed descriptions of attitudes to space utilisation within these cultures and how to design appropriate housing. In discussion with Housing New Zealand (meeting, 22 April 2009), we shared preliminary results from the index programmes and discussed issues of cultural limitations with researchers and advisors from Māori and Pacific groups. While acknowledging that ethnic groups may have different understandings on what constituted crowding, advisors were concerned about the effects of crowding on health. They explained that girls and boys should have separate bedrooms, particularly within the Pacific context. This reinforced the idea that dividing bedrooms based on the sex of individuals was appropriate. However, families might not regard a bedroom with more than two people as unacceptable as long as these protocols were followed. For example, one woman described growing up with 16 people in a four-bedroom house but never feeling they were crowded. The ACI/PPR measure may appear more neutral than an index based on bedrooms; however, as Gray pointed out in her analysis of crowding

indexes, this index relies on the unstated assumption that couples, children, and unpartnered adults have the same space requirements.

For both Māori and Pacific peoples, the importance of accommodating and maintaining closeness to kin can lead to crowding because of the mismatch between available accommodation and the needs of larger and extended families. A recent study on extended family living within Tokelauan households (Pene et al, 2009) showed that people valued extended family living but found their crowded living situation stressful. One father commented “There are nine in our family and only three bedrooms ... the lack of space and not enough bedrooms is a huge concern for me”.

There are clearly differences in cultural attitudes towards space utilisation, but attitudes to crowding are not static and can change within the wider society. For example, early in the 20th century the New Zealand Government defined crowding as more than 1.5 people per room. Under current measures (ACI) this would now be considered severe crowding. The consequences of crowding, such as poorer health outcomes, occur regardless of cultural attitudes to space utilisation.

### **Other factors that might influence perceptions of crowding**

It seems likely that factors other than cultural attitudes to space might influence perceptions of crowding. Most are difficult to measure statistically. The level of crowding (crowded or severely crowded) is likely to be important, as are dwelling adequacy and quality. Dwelling adequacy might depend on the number of bathrooms for the size of the household or on room size (factors that form part of the 1947 definition of crowding). Housing quality includes water-tightness, extent of repair, and whether the dwelling is mouldy or cold.

Other factors would depend on household members themselves – the ratio of children to adults, the capacity of adults to organise and maintain the household, financial stresses, adaptability, and sociability. Overloading in a household can also cause deterioration in housing quality, as noted by the Australian Bureau of Statistics (1996). All these factors influence the perception of crowding.

### **Considering cultural attitudes when determining which crowding index to use**

The appropriateness of an index within the New Zealand context is important for community acceptance of an index. It would be impossible for self-perception of crowding to perfectly align with a quantitative index based on limited information – because other factors identified in section 2.3 can influence a sense of crowding. It is important to note that a preference to live in an extended family setting does not equate with a preference to be crowded. For many families and households crowding is a consequence of low income, cultural preference, responsibility to accommodate kin, and the New Zealand housing situation – with its often inadequate, small, and unaffordable housing. In chapter 5 crowding indexes are applied to different ethnic groups, to discover whether different crowding indexes do affect the distribution of crowding.

Evidence cited in the literature review shows that crowding is clearly linked to poorer health outcomes, particularly for children. There is also evidence that crowding could affect mental health and educational outcomes.

Medical researchers have expressed concern about the increasing rate of close-contact infectious disease among New Zealand children, with rates much higher among Māori and Pacific children. Research is underway to study links between household crowding and these diseases. A literature review by Baker et al (2003) concluded:

...crowding is more likely to have a detrimental effect on the psychological well-being of those who are unable to find ways to reduce their stress, such as solo parents, the elderly, children and those whose network of social support has been disrupted, such as immigrants with a language barrier.

It is clear there are issues associated with crowding regardless of cultural attitudes to space. The effects may be felt particularly by Māori and Pacific peoples, as well as by smaller groups such as refugees. While the cultural and social context is important when deciding which index is the 'best fit' in the New Zealand context, the detrimental effects of crowding occur regardless of cultural context or acceptance of living situations.

## 3 Data and methods

This chapter discusses the data used in this paper and the methods used to determine which crowding index worked best within the New Zealand context.

### 3.1 Data used to investigate crowding

Data from the 1991 to 2006 New Zealand Censuses of Population and Dwellings was used to research the adequacy of the four crowding indexes described in chapter 1 (ECI, CNOS, BBS, and ACI/PPR). These four were selected because suitable data was available from the census. Most of the detailed analysis of household and individual characteristics was based on 2006 Census data.

The census is the only data source that can provide information about crowding for small geographical areas and small populations. Researchers require information at these levels to help identify social inequalities between areas (eg the New Zealand Deprivation Index) and between groups. Considerable interest exists in the health field on exploring correlations between infectious disease and crowding. While the census has comprehensive coverage, it has some limitations – largely because it is a self-completed questionnaire. The quality of the data can be affected by the complexity of the question and the detail of information in guide notes.

#### **Variables and definitions**

Census variables used to calculate the indexes are the number of bedrooms and rooms, and the characteristics of the household, which include: number of household members, number of couples, and age and sex of household members.

A household, as defined in the census, is either one person who usually lives alone, or two or more people who usually live together and share facilities (eg cooking facilities, bathroom facilities, a living area) in a private dwelling. It may include other people in addition to a family, two or more families living together, or a group of related or unrelated people.

The census definition of a room includes bedrooms, kitchens, dining rooms, lounges, family rooms, studies, and conservatories that people can sit in. Open-plan areas are counted as if they are separate rooms. Bathrooms and laundries are excluded. Bedroom counts include rooms, sleep-outs furnished as a bedroom, and caravans that are used as a bedroom. A lounge that is used for sleeping is only counted as a bedroom if the dwelling has no other bedrooms. A bedsit or studio apartment is counted as having one bedroom and one room. The full question and related guide notes for the 2006 Census are in appendix 1.

#### **Inclusions and exclusions**

The results produced from the analysis are for households in private occupied dwellings. This includes all types of private dwellings in which households may live: separate houses, units, and apartments; mobile dwellings such as caravans; improvised dwellings such as garages; and dwellings in motor camps that are the usual residence of a household. Analysis of crowding excludes people living in non-private dwellings, such as boarding houses and night shelters, as household and rooms data is not collected for these dwellings. Because bedroom indexes are based on household composition, which is only available for usual residents, crowding information excludes visitors to the household.

## 3.2 Methods

The literature review highlighted the importance of measuring crowding and, to give this paper a context, identified some of the expected characteristics of crowded households. The question of which crowding index to use is a difficult one to answer, and involves making a judgement about the 'best fit' against a range of criteria. There are three main questions to be answered.

- Is there a difference in data quality between components used to calculate the indexes and do these differences affect the results?
- Do the crowding measures identify the expected characteristics of crowded households?
- How do these crowding concepts and definitions compare with cultural and social norms in New Zealand?

These questions can be developed into assessment criteria for crowding indexes.

### **Assessment criteria for crowding indexes**

Determining which crowding index is suitable for New Zealand involves selecting an index that performs best when measured against the following criteria.

#### **Data quality**

- Is the information required by the index readily available from existing data sources? Are data used to produce the index reliable? Is there a difference in data quality for indexes based on rooms rather than bedrooms?
- To what extent do issues with component variables affect the use of the index?
- Can a time series can be produced?

#### **Effectiveness of index when compared with data expectations**

- Does each index produce the expected characteristics of crowded households (eg larger than average household size)?
- Is the index value consistent over time?
- Can this measure be used effectively at small-area level?

#### **How these crowding concepts and definitions map against cultural and social norms in New Zealand**

- Does the index used affect the distribution of crowding among different ethnic groups?
- How appropriate are the parameters of each index compared with social norms in New Zealand? (Measures considered here include the age of puberty and the age of adulthood.)

#### **Establishing data expectations**

The effective differentiation of crowded and non-crowded households is examined by analysing census data. Previous studies on crowding identified the characteristics associated with crowded households – these are used to establish data expectations. Crowding is essentially the result of a mismatch between the size and composition of a household and the capacity of a dwelling to accommodate the household's members.

Housing affordability problems are usually associated with crowding, and crowding rates tend to be much higher in places where housing is considered relatively unaffordable,

such as London in the UK. It would be surprising to find that crowded households had higher incomes (once equivalised) than households identified as not crowded.

Each index was expected to identify a population that exhibited the characteristics associated with crowding (such as larger household size, the presence of dependent children, and lower socio-economic status – as measured by lower home-ownership rates and lower household incomes). Pairs of indexes were compared to see whether characteristics of crowded households varied for selected variables. The geographical distribution of crowding under each index was compared, to determine whether different indexes affected the spatial distribution of crowding. This last point is important, because crowding is often used at a small-area level to calculate indexes of deprivation and to measure outcomes (such as rates of infectious diseases).

### **Considering the ‘best fit’**

Finally, the difficult question of which index was the best fit socially and culturally was considered. The ethnic question was particularly important because of ongoing debate about the appropriateness of applying crowding measures to different ethnic or cultural groups.

Research on crowding focuses on the health consequences of inequalities and their disproportionate impact on Māori and Pacific peoples. Therefore, an acceptable measure must be appropriate for these ethnic groups. In the literature review, it was determined that the crowding measures based on separation of boys and girls were not incompatible with the cultural attitudes of Pacific and Māori towards space. Among Pacific households particularly it was expected that boys and girls would not share bedrooms. However, a bedroom with more than two people would not necessarily be perceived as crowded.

The measures used in this paper would be unlikely to completely align with self- (or group-) defined perceptions of crowding. Other unmeasured characteristics (such as room size) are likely to be present and affect perceptions of space (or the lack of space) within a dwelling. The evidence from the literature clearly showed that crowding has detrimental effects regardless of cultural attitudes towards space utilisation within a household. Therefore it is most important to provide an accurate and consistent measure of crowding. The research did examine whether applying a particular crowding measure affected the distribution of crowding among ethnic groups – to see whether the selected index actually had an impact.

Research interest in the effects of crowding on children also means that any crowding measure should be robust in identifying crowding among children. Age distribution of crowding was examined to see if this varied by the index applied to the data.

Indexes were then compared with social norms in New Zealand. This fit involves questions such as at what age is one an adult in New Zealand, at what age is it appropriate for children of either sex to share, and at what age should a child be expected to get their own room? The questions were applied to indexes that are based on bedrooms since these indexes make assumptions about the age that pairs of children can share, whether children of different sexes should share, and at what age children should have their own room. As the results section shows, these assumptions have important consequences for identifying the number of crowded people in a population.

## 4 Results

This chapter assesses data quality and outlines the results from each index when they were applied to New Zealand census data.

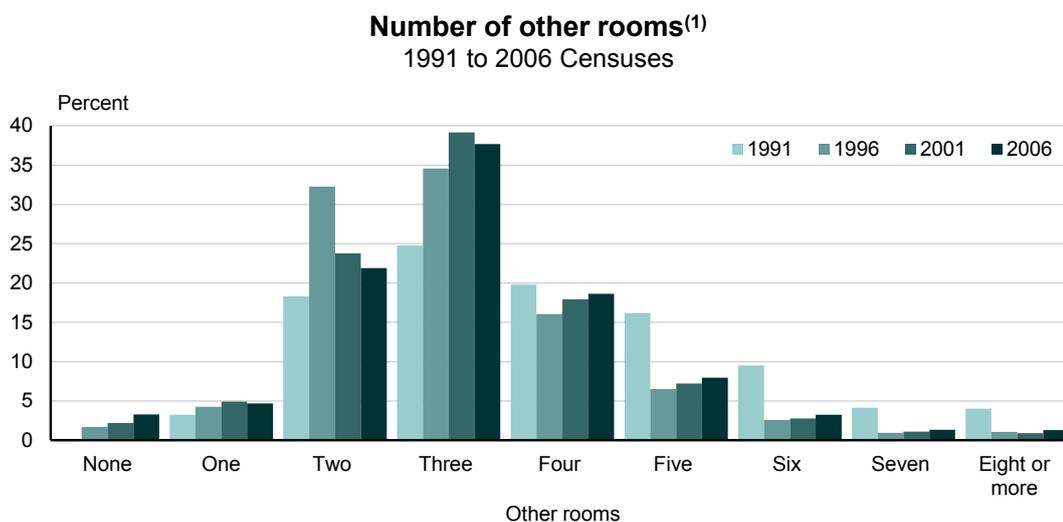
### 4.1 Data quality

Data quality is a key assessment criterion when considering which index works best for New Zealand. It became apparent when applying these indexes to New Zealand census data that there were greater data issues for indexes based on rooms than for those based on bedrooms.

#### Comparability over time

Number of bedrooms data is highly comparable over time, but there are comparability issues with rooms' data. In the 1991 Census, there were no instructions on which types of rooms to count. It is likely that respondents over-counted rooms by including bathrooms and laundries. In that year, people were asked to count the number of bedrooms and then the number of other rooms. Figure 2 shows that the 1991 Census had a much higher proportion of dwellings with five or more 'other' rooms (as well as bedrooms) than did later census years. Number of bedrooms data was much more consistent, showing a trend towards slightly larger dwellings (evidenced by more bedrooms) in later census years. This trend is reinforced by building consents data that shows a substantial increase in the floor area of new dwellings between 1990 and 2006.

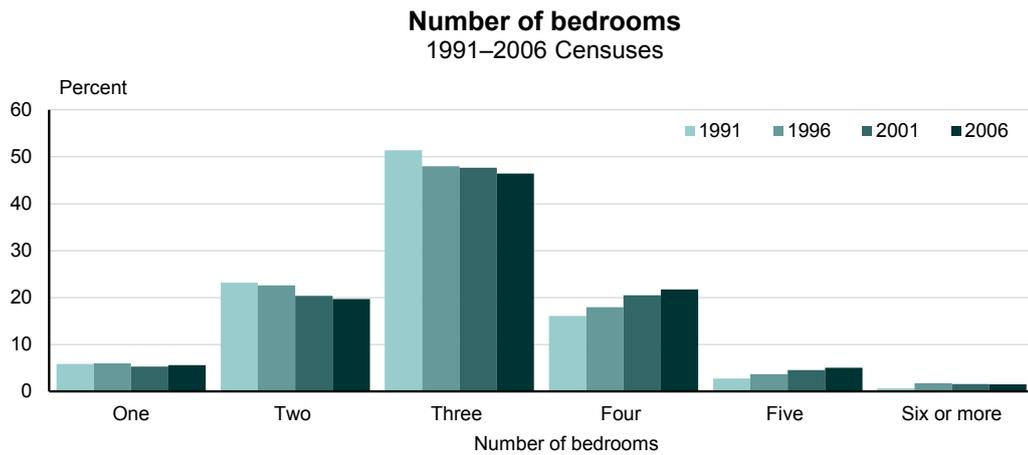
Figure 2



1. Rooms other than bedrooms.

Source: Statistics New Zealand

**Figure 3**



Source: Statistics New Zealand

Because of these issues, data for the ACI/PPR measure in 1991 is not included in the results. Morrison (1994), writing on crowding measures, noted that census staff had been unhappy with the quality of rooms data since the 1970s. This had led to the rooms question being dropped in 1986. As a result, the utility of the ACI/PPR for time-series purposes is more limited for recent years.

### Data accuracy

When census forms are processed, variables are divided into foremost, defining, and supplementary variables. The greatest attention in processing is given to foremost variables such as age, sex, and ethnicity. The numbers of rooms and bedrooms are supplementary variables and, while the data is fit-for-use, the quality is not as good as for foremost variables. Because respondents write in the number of rooms or bedrooms there may be issues with illegible writing. Data quality problems are likely to show up in small outlying categories (eg where there are a large number of rooms or bedrooms).

### Issues around counting rooms

Quality is also more dependent on respondents understanding the question for supplementary variables. Data quality for rooms is not as robust as for bedrooms – even when instructions are included this question may be more difficult to answer. It is easier to count the number of bedrooms than the total number of rooms because some rooms are not included (eg laundries and bathrooms). The absence of instructions (in 1991) resulted in a clear over-counting of rooms, probably because respondents included these rooms. The move towards open-plan living has increased the complexity for respondents – open-plan rooms are expected to be counted as separate rooms.

Data quality for this question has decreased from the 1970s onwards. In 2006, just under 3 percent of households were classified as having the same number of bedrooms as rooms (ie classified under the bedroom count as a three-bedroom dwelling, but under the room count as a three-roomed dwelling). While the cause is not entirely clear, it could be that some respondents had counted ‘other rooms’ for the rooms question rather than total rooms. This particularly affects one, two, and three-room dwelling data, where many of the severe crowding cases occur under the ACI, but which are not identified as crowded under a bedroom index.

Table 3 shows households under the ACI that were defined as crowded, by number of bedrooms and number of usual residents. Even a brief examination of the data shows a potential for households to be incorrectly classified as crowded – because of issues with rooms data. For example, in 2006 there were just over 3,000 households with three bedrooms and four usual residents. Assuming that a three-bedroom dwelling would have

at least one other room (most dwellings have two or three other rooms) this dwelling would not be considered crowded under the ACI if the rooms data was accurate.

**Table 3**

**Crowded households under the ACI**

By number of bedrooms and number of usual residents  
2006 Census

Number of bedrooms	Number of usual residents							Total
	Two	Three	Four	Five	Six	Seven	Eight +	
One	1,866	723	429	162	63	30	27	3,300
Two	0	1,293	1,839	1,911	960	321	246	6,564
Three	0	0	3,126	2,703	4,926	4,074	3,561	18,390
Four	0	0	0	1,065	867	1,479	3,231	6,642
Five	0	0	0	0	246	177	1,236	1,659
Six	0	0	0	0	0	48	339	387
Seven	0	0	0	0	0	0	102	105
Eight +	45	48	60	63	60	54	111	435
<b>Total</b>	<b>1,911</b>	<b>2,064</b>	<b>5,457</b>	<b>5,904</b>	<b>7,116</b>	<b>6,186</b>	<b>8,850</b>	<b>37,488</b>

Source: Statistics New Zealand

Table 3 highlights the poorer data quality of an index based on number of rooms.

## Non-response

It was impossible to calculate household crowding for a number of households. This was due to non-response to one or more variables required to calculate the index – for example, the number of rooms or bedrooms. In the 2006 Census, 63,528 households (4.4 percent) did not record information about the number of bedrooms and 72,693 (5.0 percent) did not record the number of rooms. Approximately 11 percent of the ‘unknowns’ under the ACI were included in the CNOS count of crowded households. In some areas where crowding was relatively high, the non-response for bedrooms and rooms was higher (around 10 percent). Just under one-third of area units had a non-response rate for rooms that was above the national figure and in one-tenth the rate was over 10 percent. The higher non-response rate could affect the accuracy of area unit statistics on crowding for indexes based on rooms and, to a slightly lesser extent, indexes based on bedrooms.

## 4.2 Data: Structure of results

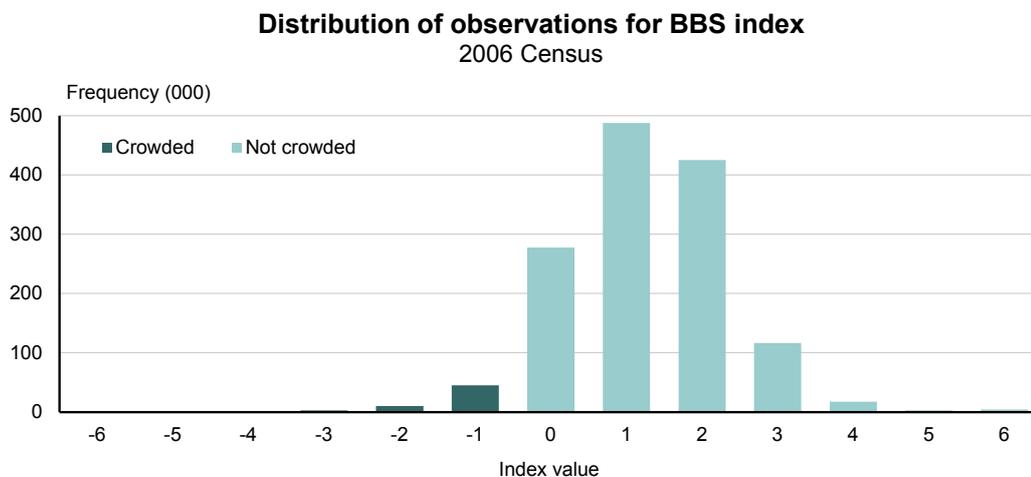
Figures 4 to 8 describe the distribution of the data before it is organised into crowding categories. For the CNOS and BBS measures, the number of bedrooms needed is subtracted from the number of bedrooms available. A zero value means that the number needed and the number available are equal. A negative value means that the household is considered crowded, while a positive value means that there are spare bedrooms. In the ECI measure, the number of bedrooms needed is divided by the number available – a value greater than 1 defines the household as crowded. Under the ACI measure, rooms are divided by the number of usual household members, and again a value greater than 1 means a household is defined as crowded.

## Distribution of values for calculating crowding indexes

Figures 4 to 8 show the distribution of observations used to calculate the crowding indexes. Once the equations are applied to the data, these values are then categorised into the various indexes. The figures show how difference measures (BBS and CNOS) differ from ratio measures (ACI and ECI). The difference measures deal with whole numbers, such as the number of bedrooms required, while the ratio measures are continuous and include part numbers. Thus even though the ECI is based on bedrooms, when it is calculated as a ratio it is more difficult to apply any underutilisation or severe

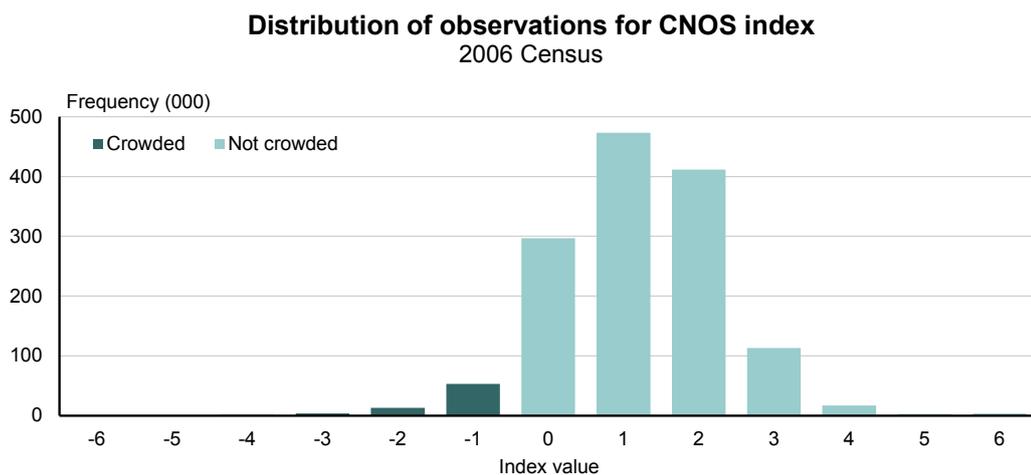
crowding measures – there is no physical reference to spare bedrooms or needed bedrooms.

**Figure 4**



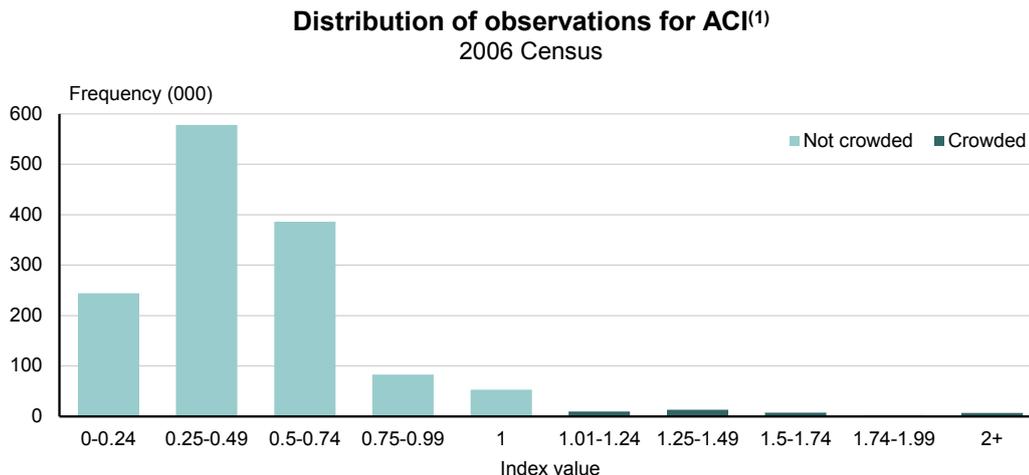
Source: Statistics New Zealand

**Figure 5**



Source: Statistics New Zealand

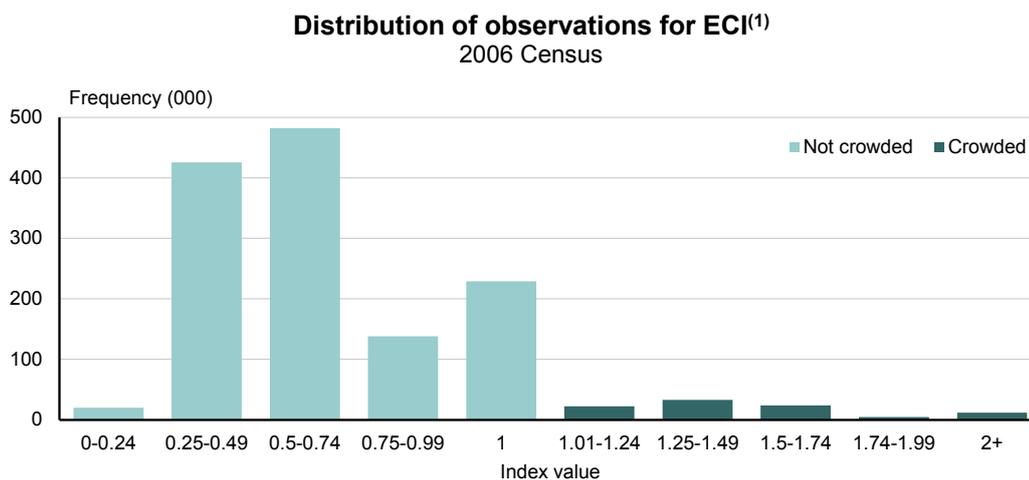
**Figure 6**



1. Value range: the number of observations up to the specified value. All values above 1 are 'crowded'.

Source: Statistics New Zealand

**Figure 7**

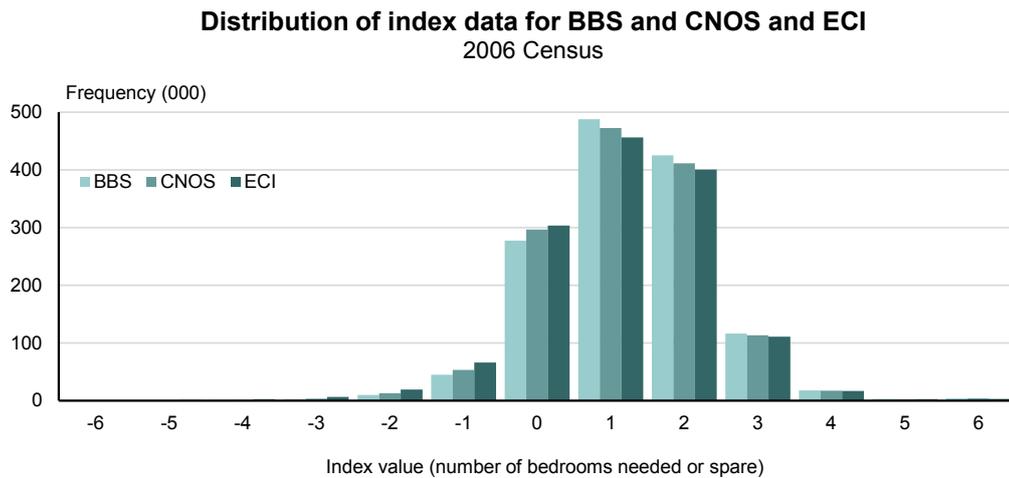


1. Value range: the number of observations up to the specified value. All values above 1 are 'crowded'.

Source: Statistics New Zealand

It is possible to translate the criteria used for the ECI into a difference rather than a ratio measure, which is easier to compare with the BBS and CNOS measures.

**Figure 8**



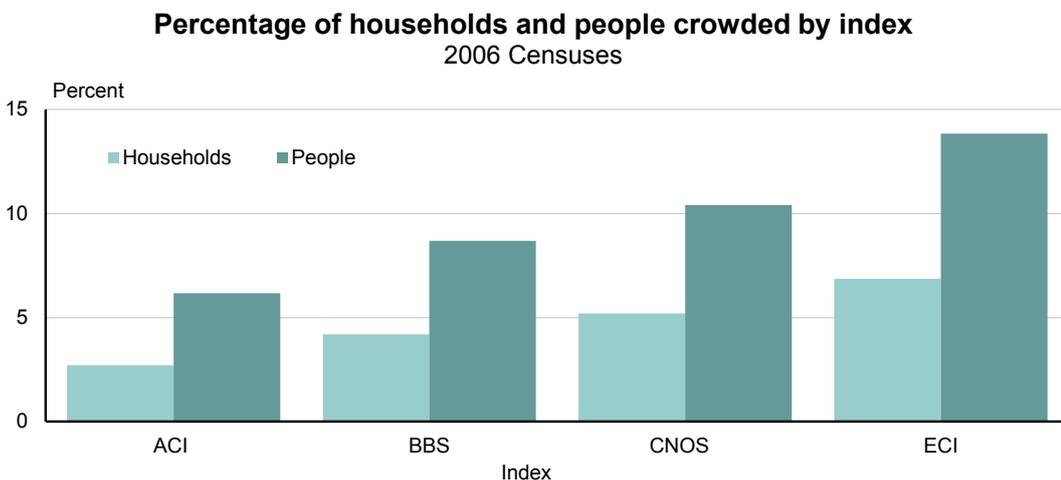
Source: Statistics New Zealand

**Note:** When the ECI is calculated as a difference rather than a ratio, nearly 400 more households are defined as crowded – because the difference measure is calculated on whole numbers (of bedrooms required).

### 4.3 Numbers and proportions of crowded households

When crowding indexes are applied to census data, the first and most significant finding is the clear difference in the levels of crowding depending on which index is used. The index selected will influence how the extent of the crowding problem in New Zealand is perceived.

**Figure 9**



Source: Statistics New Zealand

The ACI gave the smallest proportion of crowding, recording 37,500 households (2.7 percent) and 228,800 people as crowded in the 2006 Census. The ECI, which has the most generous allocation of bedrooms (a child 10 years and over should have their own bedroom), identified 95,400 households (6.9 percent) as crowded – approximately 2.5 times the number as the ACI. Under the ECI, over half a million people (516,000 people, or 13.3 percent of people in households) were identified as living in crowded conditions.

The other two bedroom measures (BBS and CNOS) produced figures in between the ACI and ECI. Under the BBS (with an older cut-off age for bedroom allocation it identifies a

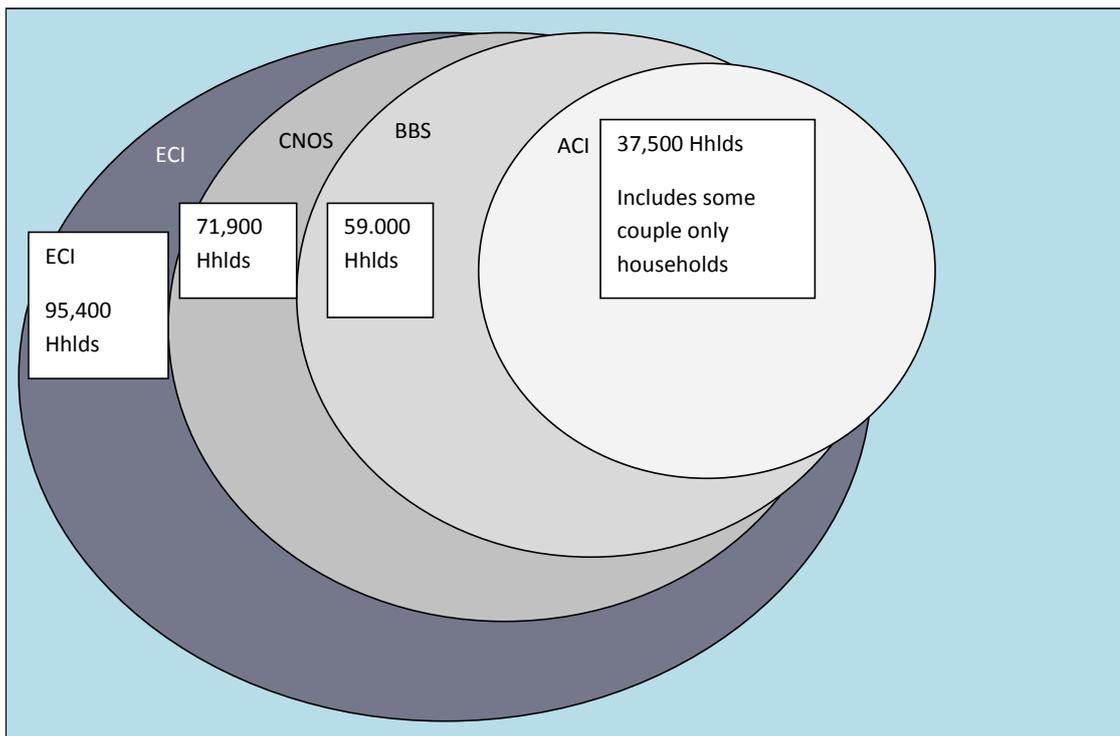
lower proportion of people as crowded), 4.2 percent of households (59,100) and 8.3 percent of people (324,600) in households were crowded. This rose slightly to 5.2 percent of households (71,900) and 10 percent of people (389,600) under the CNOS index.

These results show that any assessment of the housing need in New Zealand, as indicated by crowding levels, depends on which index is selected.

## Who is in one index and not the other?

**Figure 10**

### Comparing crowding indexes 2006 Census



When looking at households that are included in one index but not in another, figure 10 shows the ECI included most households that were defined as crowded by the other indexes. There were some discrepancies – a small number of households were included in the CNOS or BBS indexes but not in the ECI (less than 1 percent of households in BBS and 6 percent of CNOS households were not also in the ECI).

The greatest disparity occurred with the ACI. Approximately 18 percent of households included in the ACI were not in the ECI. Around one-third of crowded households in the ACI were defined as crowded under the BBS or CNOS. The example in table 4 compares the ACI with CNOS. Almost one-third of households defined as crowded under ACI were not crowded under the CNOS index.

**Table 4**

**Comparison between CNOS and ACI**  
2006 Census

ACI category	CNOS category				
	Crowded	Severely crowded	No extra bedrooms required and none spare	One bedroom spare	Two or more bedrooms spare
	Percent				
Crowded	37.0	27.6	27.9	7.2	0.3
Severely crowded	30.6	42.8	26.5	0.1	0.0
Not crowded	2.9	0.4	21.1	34.8	40.7

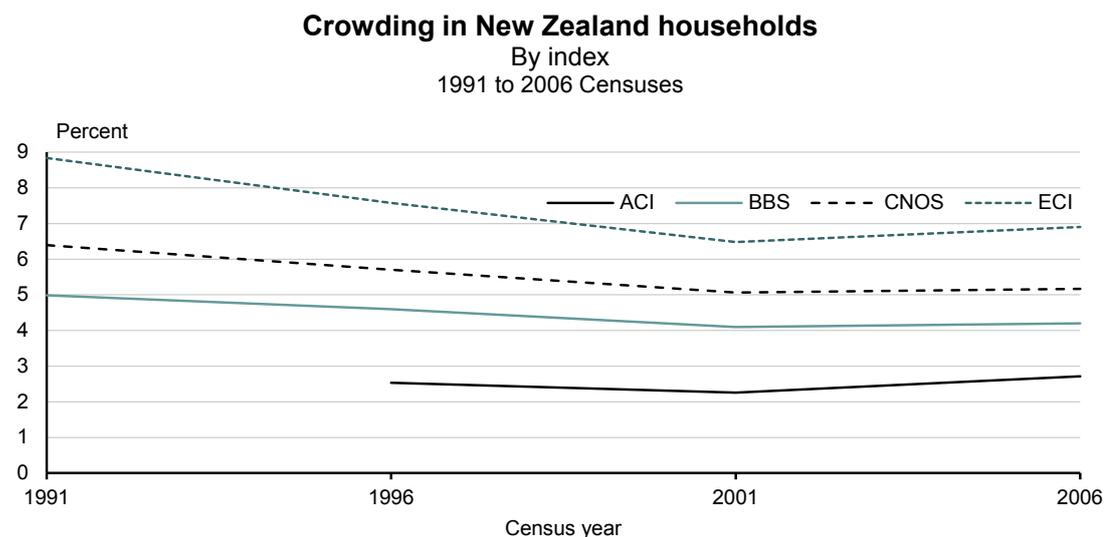
Source: Statistics New Zealand

Further analysis shows that a small proportion of the differences between the ACI and bedrooms indexes were definitional. The ACI includes couple-only households, who may live in a one-room/one-bedroom apartment – these accounted for 4 percent of all crowded households under the ACI (see table 6). Couple-only households were, by definition, excluded from the bedroom indexes, where a couple-only household cannot be defined as crowded. However, most of the disparity appears due to data quality issues, as described in the data accuracy section (see table 3).

**Do all crowding indexes work well as a time series?**

Although levels of crowding varied between the different indexes, they all follow similar trends over time, as figure 11 shows. Despite ACI being based on different data (rooms rather than bedrooms), the trend for this index was similar to indexes based on bedrooms. Between 1996 and 2001, crowding levels fell for all indexes, before rising slightly in 2006. Changes in the levels of crowding were consistent – in all years the ACI identified the lowest proportion of crowded households and the ECI the highest proportion.

**Figure 11**



Source: Statistics New Zealand

**Note:** Information not available for ACI in 1991 due to data quality issues.

Indexes based on bedrooms track crowding over a longer time period, but again the patterns are consistent.

## 4.4 Characteristics of crowded households

### Do indexes identify similar households?

The following section compares household characteristics under the different indexes, then compares the characteristics of households that were included in one index and not another.

A survey of research literature shows that crowded households are associated with certain characteristics of household size and composition as well as with indicators of socio-economic disadvantage, such as lower equivalised incomes. Crowding also tends to be concentrated among ethnic minorities, and in post-colonial societies is more common among indigenous peoples. It was therefore expected that the crowding indexes used in this study would identify households with similar characteristics.

While the crowding measures in this paper identified very different numbers of crowded households, analysis reveals that the characteristics of crowded households were similar, regardless of the measure used, and compared well with expectations.

Table 5 summarises the characteristics of households defined as crowded by different indexes. Clear differences emerge between crowded and total households. Crowded households were much larger on average, and experienced greater socio-economic disadvantage. They were more likely to have received government income support, had lower equivalised household incomes, and much lower rates of home ownership. While the ECI appeared a little different from the other indexes, with slightly higher rates of home ownership and lower rates of multi-family households, crowded households identified by ECI were still markedly different from total households.

**Table 5**  
**Characteristics of crowded households**  
2006 Census

Characteristic	Total households	Household crowding definition			
		ACI	BBS	CNOS	ECI
Number of households	1,454,175	37,488	59,091	71,871	95,394
Percent of households	100.0	2.7	4.2	5.2	6.9
Average household size	2.7	6.1	5.5	5.4	5.4
Percentage of multi-family households	2.8	26.2	23.3	21.2	17.4
Received government income support <sup>(1)</sup> (%)	23.5	56.6	62.5	61.5	57.0
Tenure: Percentage not owned <sup>(2)</sup>	33.1	65.1	66.5	65.2	60.6
Tenure: Percentage owning <sup>(3)</sup>	66.9	34.9	33.5	34.8	39.4
<b>Renting households</b>					
renting privately (%)	81.8	60.2	64.7	65.9	66.4
renting through HNZA <sup>(4)</sup> (%)	13.5	37.0	32.5	31.4	30.9
Median JEAH income <sup>(5)</sup>	\$46,100	\$32,100	\$34,400	\$34,400	\$34,000

1. Income sources are multiple response so households may have also received wage and salary income during the reference period. It is not possible to determine whether they were dependent on income support or not. Income support includes sickness, invalid's, domestic purposes, and unemployment benefits, but not New Zealand Superannuation or ACC payments.
2. Consists largely of renting households but includes a small number of households that were living rent-free, or did not state whether they paid rent.
3. Includes dwellings owned with or without mortgage, and dwellings held in a family trust.
4. Considerable census undercount of households renting through Housing New Zealand Corporation exists. Proportions are indicative only.
5. Jensen Equivalised Household Income (JEAH) adjusts income according to the number of adults and children in a household. See appendix 3 for more details.

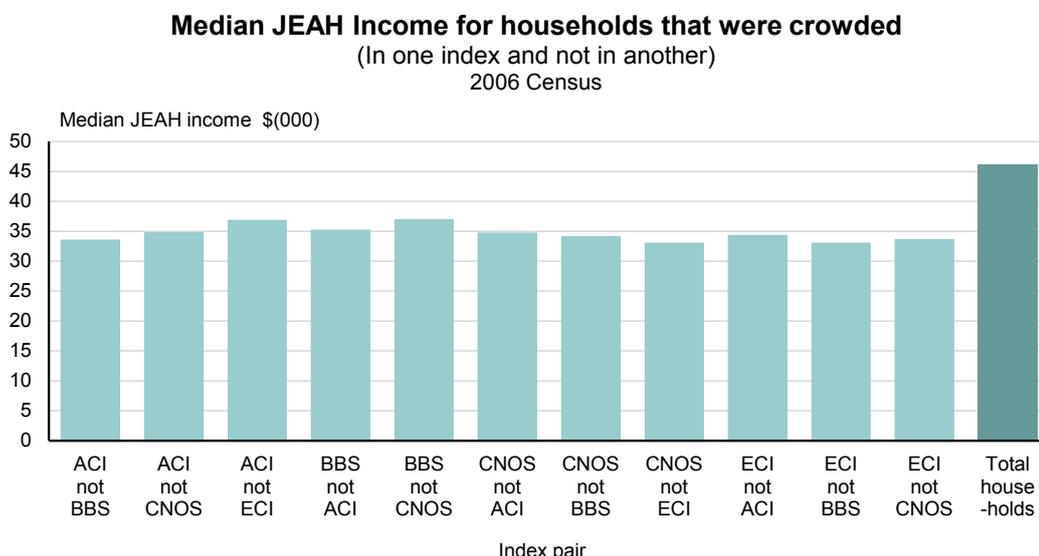
Source: Statistics New Zealand

A striking characteristic was the much lower home-ownership rate for crowded households. Although the majority of crowded households rented privately, the proportions renting through private landlords were lower than for all renting households. Crowded households that rented were more likely to be renting from Housing New Zealand Corporation (HNZC), with percentages ranging from 30.9 percent for the ECI to 37.0 percent for the ACI. These figures compare with 13.5 percent of all renting households. The Housing and Health Study (2006) highlighted a greater likelihood of crowded households among HNZC applicants, but showed crowding did reduce (but not disappear) after applicants were placed in state housing. This is consistent with patterns overseas, where crowding rates are higher for people living in social housing in the UK.

### Comparing households in one index but not in another

The differences outlined above remained for key socio-economic characteristics when households in one index but not the other were compared. Again, indexes are very similar to each other and very different from total households. For example, figure 12 compares median Jensen Equivalised Household (JEAH) income for paired indexes and total households.

Figure 12

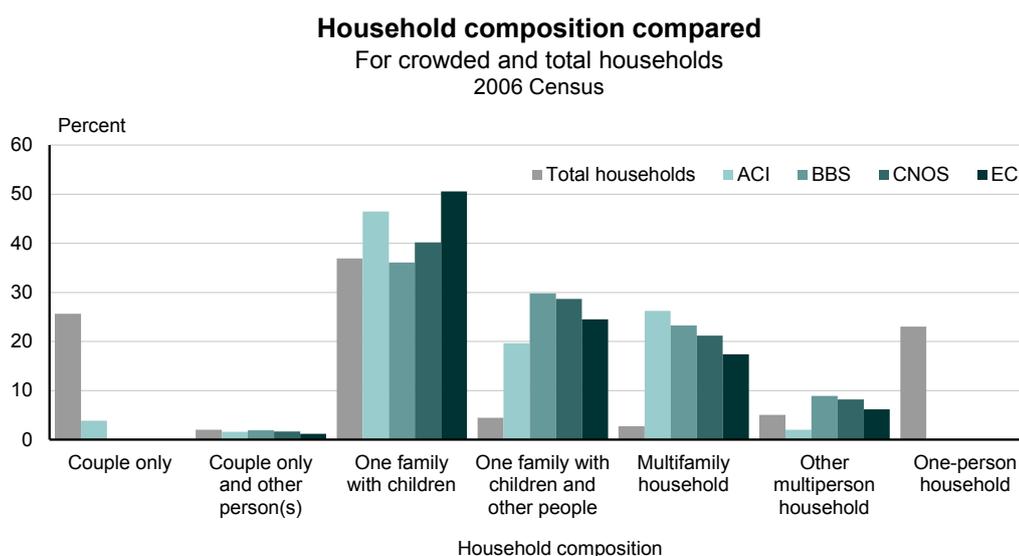


Source: Statistics New Zealand

**Note:** Total annual household income does not indicate the adequacy of that income to provide for the household. Crowded households tend to be larger on average; therefore, while an annual total household income of \$50,000 might be adequate for one or two people it is inadequate for 9 or 10 people. For a definition of JEAH income see appendix 3. The comparison between households that are in the BBS but not the ECI is omitted because of very small numbers in this category.

### Household composition and dependent children

Household composition is now considered in more depth as this variable shows some important differences between indexes.

**Figure 13**


Source: Statistics New Zealand

Using an index based on bedrooms means that, by definition, couple-only and one-person households cannot be crowded. Under the ACI, in contrast, couple-only households can be defined as crowded – there were just under 1,500 couples living in a one-room dwelling.

Table 6 shows that crowded households were likely to consist of a family that included children and other people, or more than one family. In contrast, living with others was uncommon among households in general – 4.5 percent for one family with children and others, and 2.8 percent for multi-family households. The ECI identifies a larger number of one-family with children households (consisting of ‘couple with children’ and ‘one parent with children’) that are crowded than the other indexes.

**Table 6**
**Crowded households and total households**

By household composition (condensed)  
2006 Census

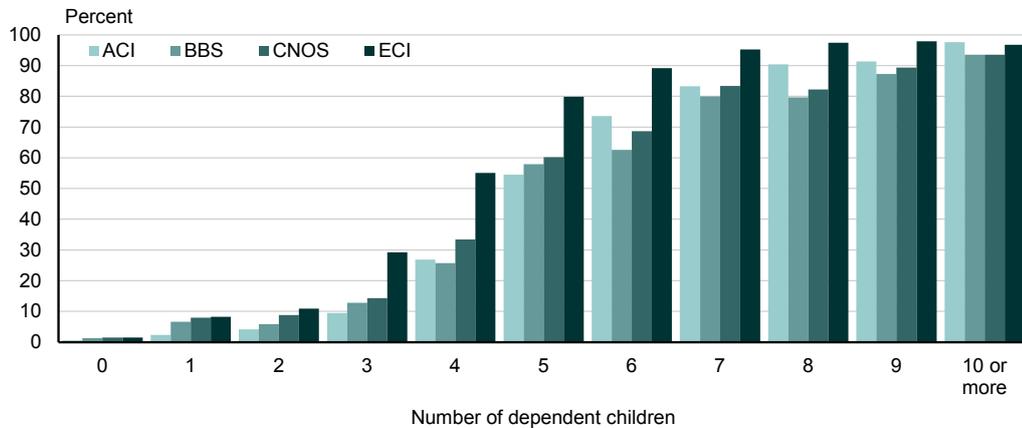
Household composition (condensed)	Total households	Household crowding definition			
		ACI	BBS	CNOS	ECI
Couple only	366,042	1,458	0	0	0
Couple only and other people	29,163	618	1,119	1,188	1,179
One family with children	526,788	17,421	21,315	28,884	48,252
One family with children and other people	63,552	7,377	17,598	20,607	23,415
Multi-family household	39,609	9,828	13,761	15,255	16,611
Other multi-person household	72,657	774	5,268	5,904	5,934
One-person household	328,302	0	0	0	0

Source: Statistics New Zealand

Crowding appears to be associated with complex family composition (multiple families) and with the presence of dependent children. Very few households without dependent children were crowded, but in households with many dependent children almost all were crowded. Again the distribution between indexes was very similar, although the ECI index identified higher proportions of households with dependent children as crowded and this difference started earlier – for households with three dependent children.

**Figure 14**

**Proportion of households that were crowded**  
By number of dependent children  
2006 Census



Source: Statistics New Zealand

The following section shows that household characteristics vary further when crowded households are compared with severely crowded households.

**Should crowding indexes include measures of severe crowding through to underutilising dwellings?**

**Severely crowded housing**

Some crowding indexes, such as the ACI and CNOS, include a ‘severe crowding’ category. Health studies show that while crowding is associated with infectious disease, the severity of crowding is also a factor. As the Canadian Communicable Diseases Report (2007) showed that TB transmission increased sharply with even a small increase in the severity of crowding.

This section includes a brief examination of whether including space utilisation categories gives valuable additional information. For this paper, a severely crowded category was added to the BBS and ECI. Because the ECI is a ratio measure, it is more difficult to create a severe crowding value, as it does not wholly equate to number of bedrooms required. An approximate value was created (1.6 or more). Both the CNOS and BBS measures include bedroom underutilisation.

**Table 7**  
**Crowded<sup>(1)</sup> and severely crowded<sup>(2)</sup> households**  
 By selected characteristics  
 2006 Census

Characteristic	Household crowding definition							
	CNOS (just crowded)	CNOS (severely crowded)	ACI (just crowded)	ACI (severely crowded)	BBS (just crowded)	BBS (severely crowded)	ECI (just crowded)	ECI (severely crowded)
Number of households	53,403	18,468	26,217	11,268	45,123	13,965	65,862	29,532
Percent of households	3.8	1.3	1.9	0.8	3.2	1.0	4.7	2.1
Average household size	4.8	7.1	6.1	6.2	4.9	7.3	5.2	5.9
Percentage of multi-family households	15.1	38.9	25.2	28.6	17.4	42.5	14.7	23.4
Received government income support <sup>(1)</sup> (%)	58.1	71.5	56.7	56.2	59.6	72.0	54.0	63.7
Tenure: Percentage not owned <sup>(2)</sup>	64.7	65.7	63.4	69.4	66.3	67.1	56.4	70.3
Tenure: Percentage owned <sup>(3)</sup>	35.3	34.3	36.6	30.6	33.7	32.9	43.6	29.7
<b>Renting households</b>								
renting privately (%)	70.4	52.6	61.0	58.3	68.7	51.5	70.7	59.4
renting through HNZC <sup>(4)</sup> (%)	26.9	44.8	36.3	38.5	28.4	45.8	27.0	37.2

1. Income sources are multiple response so households may have also received wage and salary income during the reference period. It is not possible to determine whether they were dependent on income support or not. Income support includes sickness, invalid's, domestic purpose, and unemployment benefits but not New Zealand Superannuation or student allowances.
2. Consists largely of renting households but includes a small number of households that were living rent-free, or did not state whether they paid rent.
3. Includes dwellings owned, and dwellings owned through a family trust.
4. Considerable census undercount of households renting through Housing New Zealand Corporation exists. Proportions are indicative only.

Source: Statistics New Zealand

In table 7, for the ACI, many household characteristics appear fairly similar regardless of whether a household is crowded or severely crowded. In contrast, differences between these categories were more marked under the BBS and CNOS indexes. Household size was much larger in the severely crowded category under both the CNOS and BBS indexes (7.1 and 7.3 (for severely crowded) compared with 4.8 and 4.9 (for crowded), respectively). The crowded and severely crowded categories under the ECI show some differences but the contrast is less extreme, except for tenure. Other socio-economic characteristics, such as education and employment, worsen with severity of crowding.

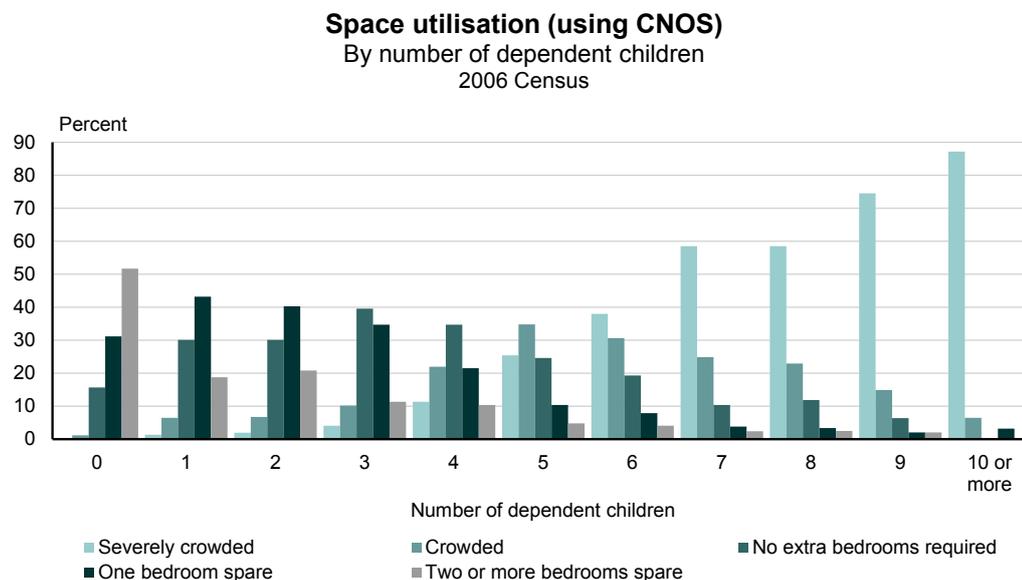
It is likely that the poorer quality of rooms data (see section on data accuracy) may have skewed results for the small number of severely crowded households under the ACI. This reinforces the poorer quality of the ACI relative to indexes based on number of bedrooms.

### Underutilised housing

Although much of this paper's analysis concentrates on crowding, there is also interest in the characteristics of households that are not crowded. Information about underutilisation of dwellings provides a useful background for understanding the context of crowding, for both the general population and different ethnic groups. Two examples show the differences in distribution of dependent children and median JEAH income for different crowding and underutilisation categories. Figure 15 shows the number of dependent children for the full CNOS range, from severe crowding to households with two or more

spare bedrooms. Figure 16 shows the distribution of JEAH income across selected crowding categories.

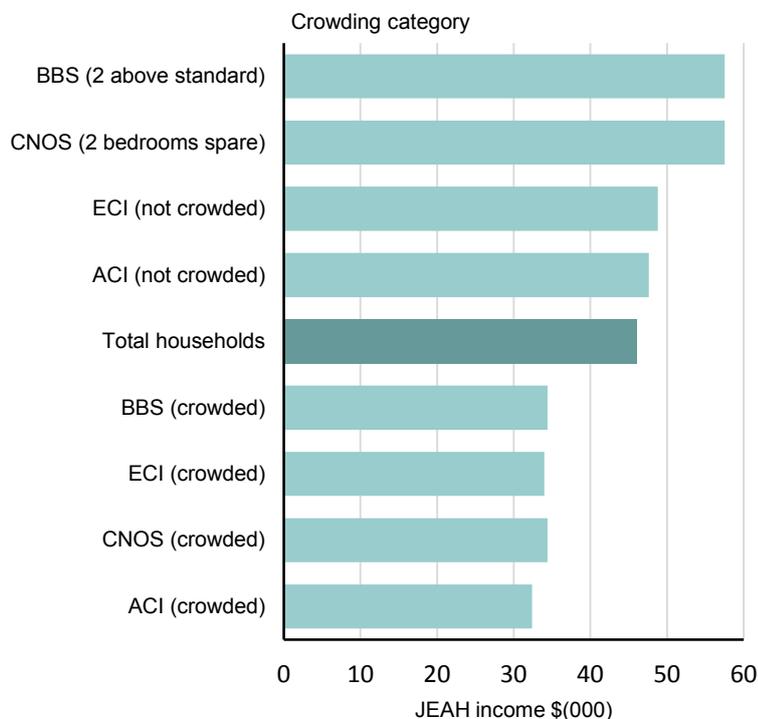
**Figure 15**



Source: Statistics New Zealand

**Figure 16**

**Median JEAH income by selected crowding categories**  
2006 Census



Source: Statistics New Zealand

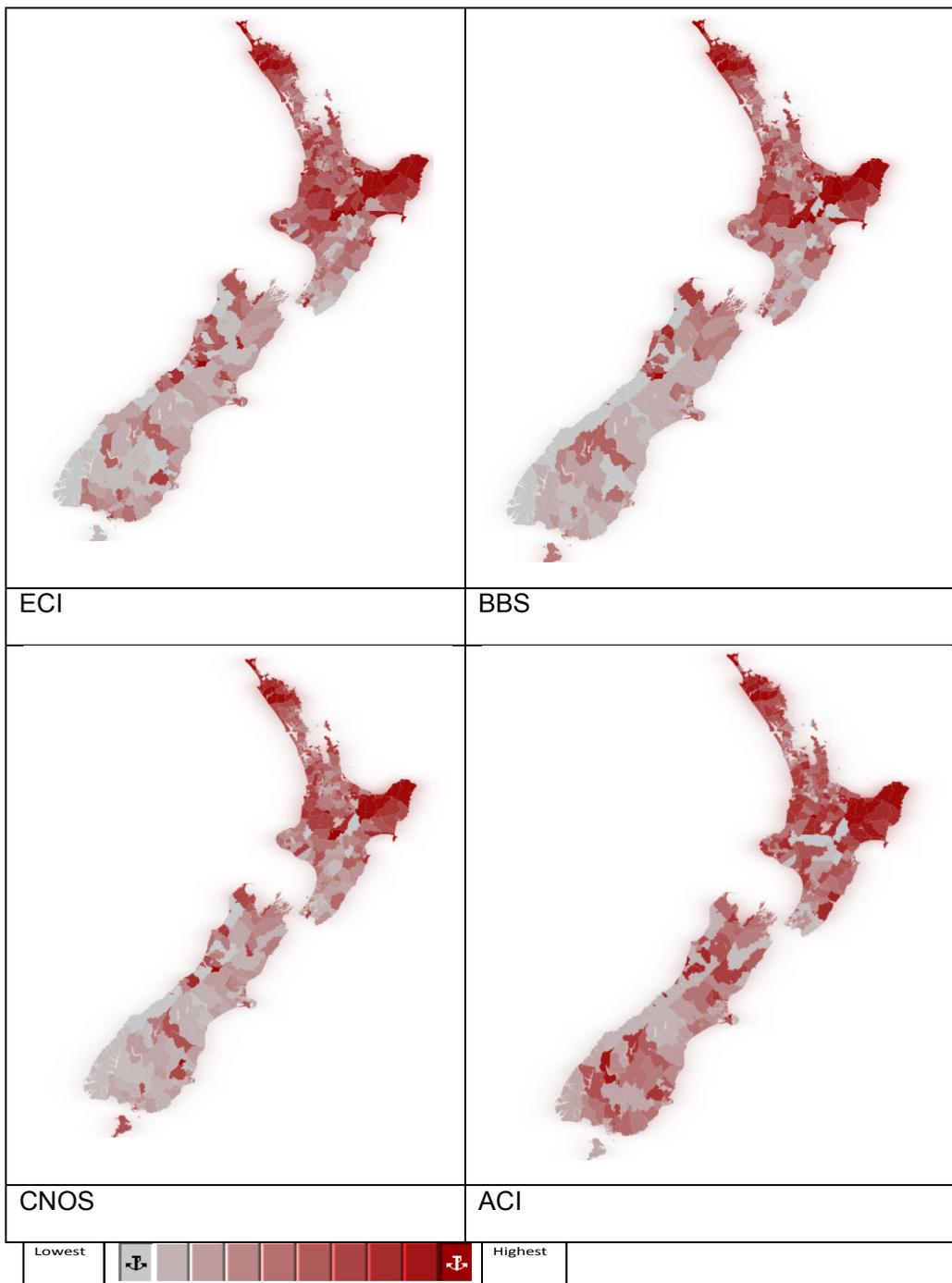
**Note:** Non-response rates were very high for severely crowded households, and numbers were small, so JEAH income is not included for that category.

It seems useful for a crowding index to include categories showing a range of space utilisation. The BBS or CNOS indexes seem to perform better in this context than the ACI and are more easily understandable as they are based on allocating bedrooms by household composition and age.

### Do different indexes affect the geographical distribution of crowding?

Figure 17

Different measures of household crowding in New Zealand  
2006 Census



Much of the geographic analysis for this paper was carried out using the geovisualisation tool geoviz. An area unit dataset containing a number of variables was compiled. The variables included occupancy rate, ethnicity (total response), the four crowding

measures, and the number of households (to check on whether outliers were occurring because of small numbers). The dataset was created to explore the distribution of crowding and the correlation between different variables by area unit. Work on the geographic distribution of crowding shows that crowding varies considerably according to location, with crowding being concentrated in Auckland, Northland, and Gisborne.

Crowding is used at a small-area level to identify high housing need, as a variable within deprivation indexes, and to explore the link between crowding and infectious disease. Therefore the question of whether different crowding indexes affect the geographical distribution of crowding is important.

In the following section, distributions of crowding at regional, territorial authority, and area unit level are considered.

## Crowding is concentrated in certain geographic areas

As table 8 shows, Auckland, Gisborne, and Northland have the greatest proportion of crowded households under all four indexes. Ranking was consistent between indexes, although under the ECI, Gisborne had a slightly higher proportion of crowded households than Auckland.

**Table 8**

**Percentage of crowded households by region<sup>(1)</sup>**  
2006 Census

Region	Percentage crowded			
	ACI	BBS	CNOS	ECI
Auckland	4.6	6.9	8.2	10.0
Gisborne	4.2	6.5	7.8	10.7
Northland	3.2	4.9	5.8	7.9
<b>New Zealand</b>	2.7	4.2	5.2	6.9
Hawke's Bay	2.4	4.1	5.1	7.0
Bay of Plenty	2.7	4.2	5.0	6.9
Waikato	2.4	3.8	4.7	6.7
Wellington	2.1	3.8	4.6	6.1
Manawatu-Wanganui	1.7	2.7	3.4	5.2
Taranaki	1.4	2.3	2.9	4.8
Canterbury	1.2	2.2	2.9	4.2
Marlborough	1.3	2.2	2.7	4.0
Nelson	1.2	2.0	2.7	4.1
Tasman	1.5	2.0	2.6	3.9
Otago	1.0	1.7	2.3	3.5
West Coast	1.2	1.6	2.1	3.7
Southland	1.0	1.5	2.0	3.7
Area outside region	1.3	1.3	1.8	4.0

1. Ranked by CNOS.

Source: Statistics New Zealand

Regional variation was similar when crowding was calculated at individual rather than household level. Auckland, Gisborne, and Northland had the highest proportions of people living in crowded households.

At territorial authority level, the cities of Manukau, Auckland, and Poirirua, and the Opotiki and Kawerau districts had the highest proportions of crowded households – regardless of which crowding index was used (see table 9). Numerically, Manukau, Auckland, Christchurch, and Waitakere cities had the largest number of crowded households under all the indexes.

**Table 9**

**Percentage of crowded households in most- and least-crowded territorial authority areas<sup>(1)</sup>**  
2006 Census

Territorial authority	ACI	BBS	CNOS	ECI
<b>Most crowded</b>				
Manukau city	8.5	11.7	13.8	16.6
Opotiki district	5.5	8.4	9.8	12.9
Auckland city	4.8	7.7	8.9	10.2
Porirua city	4.8	7.3	8.9	11.6
Kawerau district	4.9	7.3	8.6	11.9
<b>Least crowded</b>				
Timaru district	0.7	1.0	1.5	2.7
Southland district	1.1	1.1	1.4	3.2
Central Otago district	0.9	1.0	1.4	2.4
Waitaki district	1.0	0.9	1.2	2.6
Waimate district	0.7	0.7	1.1	2.5

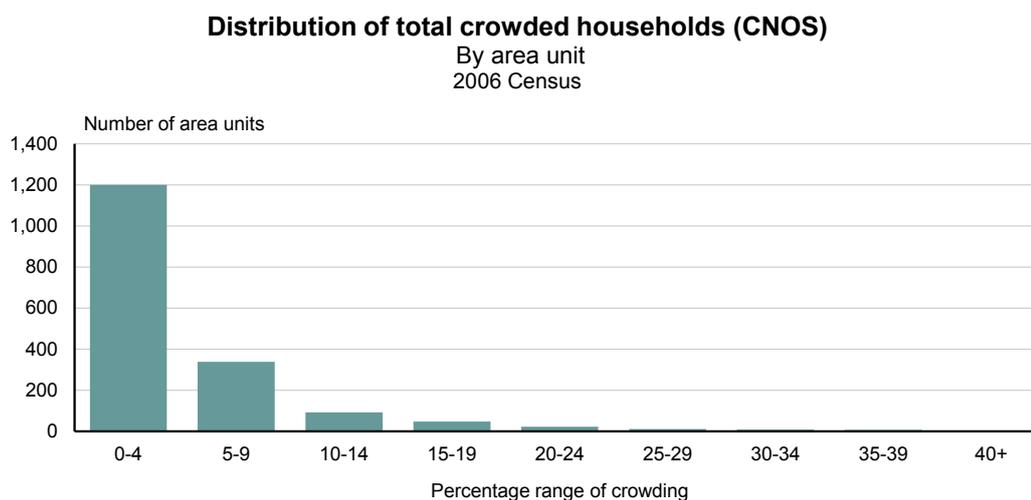
1. See appendix 4 for crowding levels in all territorial authority areas.

Source: Statistics New Zealand

**Does the crowding index selected make a difference at area-unit level?**

Figure 18 shows the location-specific nature of crowding by exploring the distribution of crowding at area-unit level. The distribution is skewed, with most area units having very little crowding and a small number of area units having high proportions of crowding.

**Figure 18**



Source: Statistics New Zealand

Table 10 shows that, even at area unit level, the distribution of crowding showed little variation by index used. These area units are at the extreme end of the crowding distribution.

**Table 10**

**Area units in New Zealand with the highest proportion of crowded households  
Ranked by CNOS  
2006 Census**

Area unit	Area unit code	ACI	BBS	CNOS	ECI
		Percent			
Ferguson	523602	36	44	48	54
Otara West	523402	31	39	43	50
Otara South	523601	32	39	42	49
Harania North	524510	29	35	40	50
Otara North	523501	30	34	40	45
Otara East	523502	29	35	39	45
Flat Bush	523711	28	36	39	44
Viscount	524122	27	34	38	45
Harania East	524530	26	33	37	42
Arahanga	524121	26	32	37	42
Mascot	524112	24	32	35	41
Mangere Central	524111	23	30	35	43
Clover Park	523721	25	32	35	40
Favona West	524403	25	31	34	42
Harania West	524520	22	30	33	39

Source: Statistics New Zealand

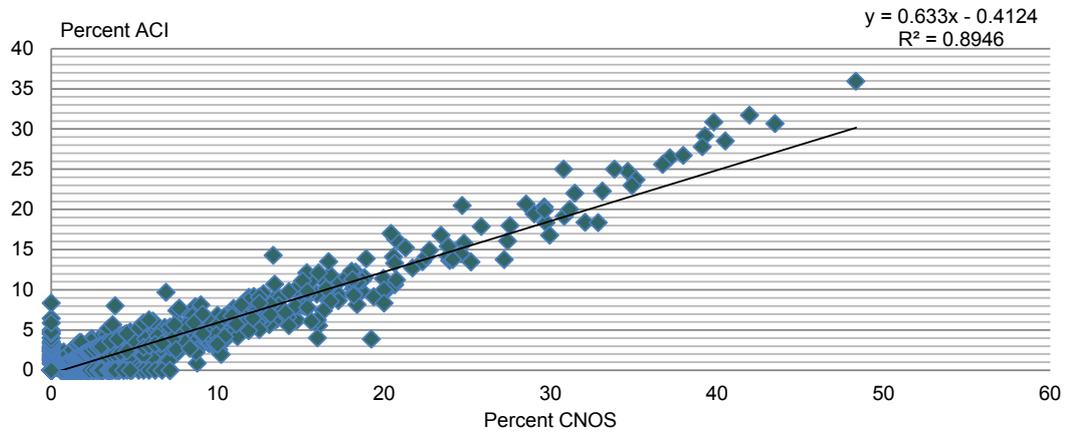
Again there was variation in ranking, but this was minimal. Most variation occurs in area units with very small populations, where including or excluding a few households can skew the result for the area unit.

### Correlations between indexes

Geoviz is a useful tool to analyse correlations between indexes, to see how consistent these are at a geographical level. A correlation of 1 means a perfect agreement between the percentages of crowding in an area unit. There was a very strong correlation between different crowding indexes, with the strongest being between bedroom indexes at an area unit level (between 0.96 and 0.97). Correlations were slightly lower between the bedroom and rooms indexes at an area unit level. For example, figure 19 shows the correlation between proportions of crowded households at area unit level under the ACI and CNOS indexes. It is likely that some of the variability is due to small numbers in some area units and some data quality issues.

**Figure 19**

**Correlation between percentages of households**  
(That were crowded at area-unit level (ACI and CNOS))  
2006 Census



Source: Statistics New Zealand

**Note:** Extreme outliers were in area units with very small populations.

Area units with less than 40 households were excluded from this analysis. If area units with less than 100 households are excluded, the correlation between areas increases to an  $R^2$  of 0.92.

In table 11, all indexes show a strong correlation between area units with high proportions of Pacific people and severe crowding. Correlations with other ethnic groups were weaker, although there was evidence of an inverse relationship between area units with high percentages of people with European ethnicity and severe crowding. Little variability appeared in the correlations of severe crowding and area units for people of Pacific or European ethnicity, but a much greater variability appeared for Māori ethnicity, particularly between the ACI and bedroom indexes.

**Table 11**

**Correlation between severe crowding at area unit level and selected ethnicity**  
By index  
2006 Census

Index (households)	Correlation between severe crowding and ethnicity		
	Pacific peoples	Māori	European
ECI	0.8321	0.5153	-0.6400
BBS	0.8404	0.4584	-0.6600
CNOS	0.8440	0.4743	-0.6640
ACI	0.8424	0.3989	-0.6040

**Note:** A correlation of 1, or -1 represents a perfect correlation, whereas the greater the difference from 1 the weaker the relationship between two variables.

Source: Statistics New Zealand

In conclusion, although there is variation in levels of crowding between indexes, the index used makes very little difference to the geographical spatial distribution of crowding. This is evident at regional, territorial authority, or area unit level.

## 5 Identifying the index that fits best with New Zealand's cultural and social norms

This chapter explores the distribution of crowding by ethnicity and age for each crowding index, then examines how effectively the indexes map against social and cultural norms in New Zealand.

### 5.1 Distribution of crowding by ethnicity showed little variation by index

#### Ethnicity

Crowding varies markedly by ethnic group, both in New Zealand, and in comparable countries such as the United States, the United Kingdom, Canada, and Australia. Minority populations, including indigenous people, experience much higher levels of crowding than the general population. A study in California (Moller et al, 2002) noted that Black, American Indian, Asian, and Hispanic populations in the United States had much higher levels of crowding. This difference remains significant even when controlling for factors such as low income. In New Zealand, for example, people with European ethnicity consistently experience the lowest levels of household crowding while Pacific peoples experience the highest levels.

Researchers have criticised the use of crowding indexes in New Zealand without research into cultural views on crowding among Māori and Pacific peoples. Schluter et al (2007) suggested that a self-reported measure of crowding generated better results among Pacific people than either the American or Canadian indexes. They suggested the ECI was perhaps 'oversensitive' to Pacific living situations and this was the reason the ECI identified many more Pacific households as crowded. It was also the reason for a poor correlation with self-reported perception of crowding. Presumably 'oversensitivity' in this context implies that some characteristic of Pacific households may be picked up disproportionately by one index (in this case ECI) and not by another.

The question of whether certain crowding indexes are biased towards some ethnic groups is important – an index that identifies a much greater proportion of crowding than self-perception does shows poor alignment with community values and risks seeming irrelevant. However, adopting a culturally specific crowding index involves specific issues. It would be possible to generate an index based on the values of a particular ethnic group, but this would mean a loss of comparability with other ethnic groups. Having three or four people in a bedroom may not contravene cultural values about using space but does lead to an increased disease risk. The Australian Bureau of Statistics is investigating adapting the CNOS index for an indigenous-specific index that will take into account the differing use of space in remote areas (eg people sleeping outside under verandahs). While this measure may be appropriate in Australia, it is less applicable in New Zealand with its greater climatic extremes. Neither would it account for the load on sanitary facilities in a dwelling. It seems preferable to apply an index to the whole population but to acknowledge that any index is arbitrary.

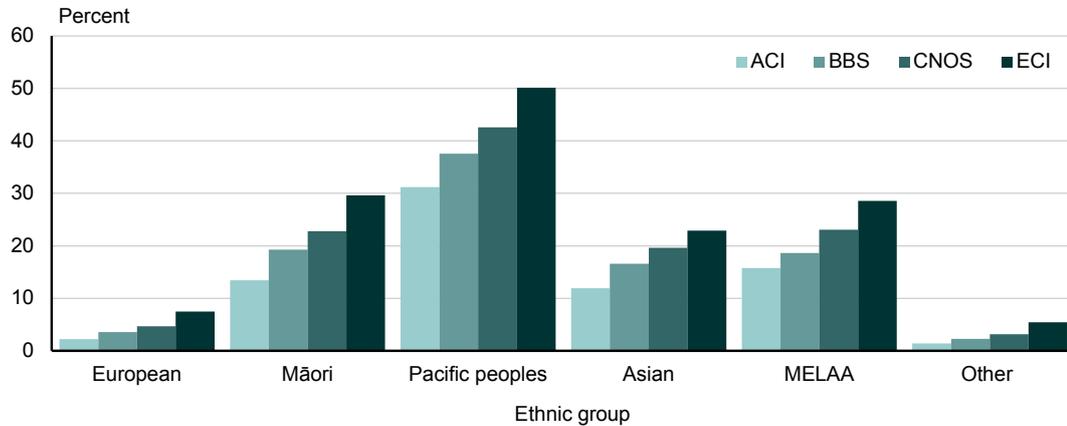
#### **Does the index used affect the distribution of crowding, by ethnicity?**

Does applying different crowding indexes produce markedly different results by ethnic group, as suggested by previous research? This paper has shown the ECI identified much greater numbers of crowded people and households, while the ACI identified much smaller numbers. Different indexes therefore do produce different levels of crowding, because of their definitional criteria. Therefore it can be expected that ethnic data would follow a similar pattern. Any deviation from this pattern for particular ethnic groups might reveal a bias towards particular groups.

In the following analysis both total response and single/combination ethnicity are used.

**Figure 20**

**Percent of people living in crowded households for all indexes**  
By ethnic group (level 1)  
2006 Census



Source: Statistics New Zealand

Figure 20 and table 12 show that the distribution of crowding for ethnic groups follows the expected pattern. The ECI identifies the highest levels of crowding and the ACI the lowest levels, regardless of ethnic group. This pattern appeared consistent whether total response or single combination ethnicity was used.

**Table 12**

**People in crowded households**

By ethnicity (total responses)

2006 Census

Ethnicity	Index			
	ACI	BBS	CNOS	ECI
European	53,277	85,851	113,697	181,272
Māori	68,397	98,976	117,012	152,169
Pacific peoples	73,893	91,332	103,557	121,848
Asian	39,159	55,023	65,091	75,969
Middle Eastern/Latin American/African	4,959	5,946	7,377	9,120
Other ethnicity	5,721	9,387	12,738	22,125

1. Includes everyone who stated each ethnic group, whether as their only ethnic group or as one of several ethnic groups. Where a person reports more than one ethnic group, they are counted in each applicable group. For example, if an individual gives Māori and European as ethnicities they could be counted as living in crowded conditions under both categories.

Source: Statistics New Zealand

**Table 13**

**People living in crowded households**

By selected single/combination ethnicity  
2006 Census

Single/combination ethnicity	Index			
	ACI	BBS	CNOS	ECI
European only	30,999	52,410	71,529	121,914
Māori only	45,060	65,043	75,003	94,218
Pacific only	61,746	74,277	83,127	95,874
Asian only	36,519	51,186	60,399	69,864
MELAA only	4,596	5,421	6,702	8,187
Other only	4,197	6,888	9,492	17,382
European & Māori	14,490	21,723	27,474	39,414
Pacific & Māori	4,632	6,240	7,188	8,760

**Note:** Other includes New Zealanders. MELAA is Middle Eastern, Latin American, and African.

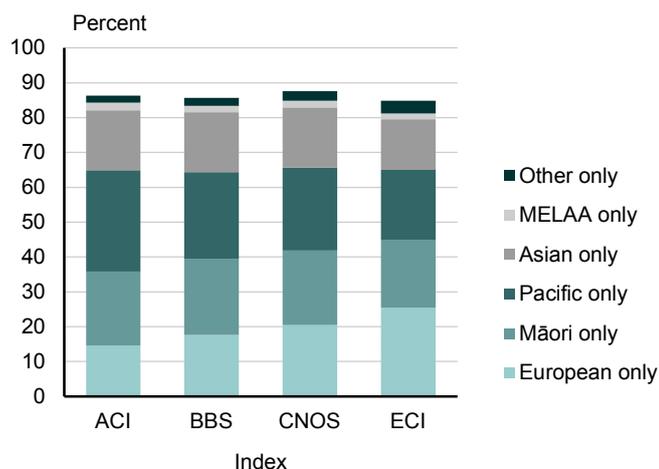
Source: Statistics New Zealand

When looking at the proportion of the crowded population that identifies with a particular ethnic group, rather than the proportion of the ethnic population that is crowded, there are small differences between indexes. In figure 20, just over 80 percent of all people who were crowded identified with only one ethnic group. Pacific peoples make up the largest proportion of the crowded population under the ACI, BBS, and CNOS measures but not under the ECI. People who identified as European were only one-quarter of all the crowded population under the ECI. The ACI, in contrast, had the lowest proportion of people identifying with European ethnicity and the highest proportion identifying with Pacific ethnicity.

**Figure 21**

**Proportion of people crowded**

By single response ethnicity (level 1) and index  
2006 Census



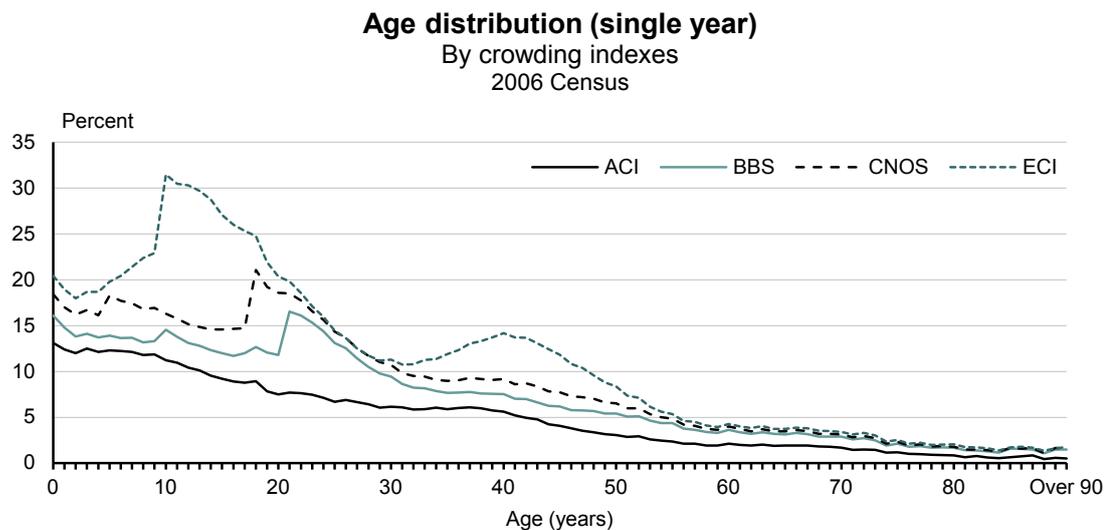
Source: Statistics New Zealand

In conclusion, the distribution of crowding levels among ethnic groups followed the same general distribution as for the total population, despite small differences between indexes.

## 5.2 How the indexes affect the age distribution of crowding

Different crowding indexes do affect the age distribution of crowding. Because age is a component of the bedroom indexes (but not the ACI), age cut-offs affect certain ages. This is most notable for distributions by single year of age. There is less effect when age groupings are used – for example, when looking at the proportions of children that are crowded. The effect occurs at the age a person is considered to need their own bedroom – in the CNOS index 18 years is the age experiencing the highest level of crowding, in the BBS it is 21 years, and for the ECI 10 years. The ECI shows the largest effect on age distribution. It identifies more 10- to 17-year-olds as crowded than other measures do, as seen in figure 22.

**Figure 22**



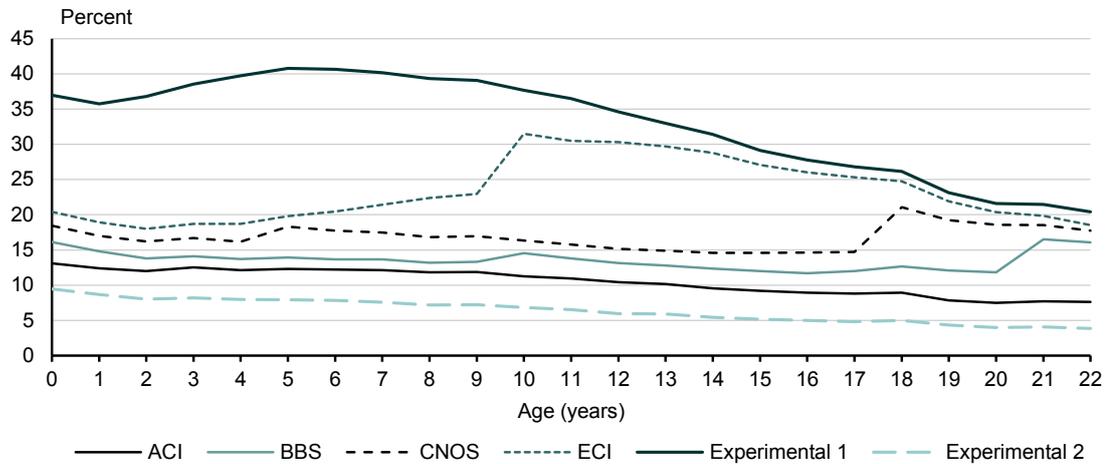
Given the importance of measuring crowding accurately for children (who appear most affected by the consequences of crowding), which age cut-off fits best with New Zealand's social norms? And what is the actual distribution of bedroom allocation in New Zealand?

In figure 23, two experimental indexes allow observation of the age distribution of crowding if the distortionary effects of age cut-offs are removed. In the first experimental index, couples are allocated a bedroom and all other household members are each allocated a bedroom, regardless of age or sex. This index increases the number of people defined as living in crowded conditions to over 700,000. It raises the crowding level sharply for children, but results in a much smoother age distribution – crowding peaks between four and seven years, declines steadily to 17 years, then declines more sharply after age 18 years.

In the second experimental index, two people may share a bedroom. For example, if there are six people and three bedrooms, the household is not counted as crowded. For this index, the number of people crowded reduces to just over 100,000 (well below the ACI level) and the distribution is very similar to the ACI.

**Figure 23**

**Age distribution (single year) for people 22 years and under**  
By crowding indexes  
2006 Census



Source: Statistics New Zealand

While a difference in age distribution emerges with the experimental series, the broad pattern is similar. In all indexes, children (0–14 years) and young people (15–24 years) have the highest levels of crowding. However, the ECI defines a much larger proportion of children aged 10 and over as crowded, so may be a less-appropriate measure for any research requiring a tight definition of crowding (eg health-related research).

### 5.3 How the indexes align with social norms in New Zealand

The results section shows that all indexes differentiated crowded from non-crowded households; although differences emerged, particularly around data quality. Bedroom data was more reliable than rooms data – this affected the quality of the ACI and made it less suitable for analysis. Because of data quality issues, the ACI is not recommended as the most suitable index for New Zealand.

The most suitable index will therefore come from the three bedroom indexes examined in this paper – BBS, CNOS, and ECI. Deciding which crowding index to select depends largely on how well each index reflects social norms in New Zealand. The ECI identifies a greater number of households on the margins of being crowded, particularly larger one-family households. In practice, this results in more people with European ethnicity being identified as crowded. The CNOS and BBS measures produce very similar results (except in the number of households affected by crowding) and seem to produce a good range of information, from severe crowding to bedroom underutilisation.

#### Age thresholds and puberty

The bedroom indexes use a combination of couple status, age, and (for the BBS and CNOS) sex to calculate crowding. In the ECI, pairs of children of either sex who are under the age of 10 years can share a bedroom, but all children over 10 are allocated their own room. Under the BBS and CNOS indexes, pairs of children who are under 10 years (BBS), or under five years (CNOS) can reasonably share a bedroom, but only pairs of children of the same sex should share a room after these ages (until allocated their own bedroom at age 21 years for the BBS and 18 years for CNOS). The age/sex separation threshold involves assumptions about the age of puberty. The bracketed age threshold involves assumptions about the age of adulthood. Neither definition is straightforward.

In New Zealand it is generally considered acceptable for children of the same sex to share a room before puberty but not afterwards. Recent studies (eg Riggs, 2006) indicate the age of puberty is falling for boys and girls, with girls now entering puberty between nine and 14 years. Riggs notes that in 2000, Bristol University's Institute of Child Health reported that one in six girls had started to show signs of puberty by the time they were eight. The study also showed that one in 14 eight-year-old boys had pubic hair, compared with one in 150 boys in their fathers' generation. This research suggests the sexes should be separated before the age of 10. Sleep separation of boys and girl is common in many cultures. Housing New Zealand's Pacific housing design guidelines state:

The female family members, especially young girls and teenagers, are also accommodated inside, always separate from the males. Sleep-outs, as part of an overall design, are reserved for the teenage male family members.

While there is no definitive answer as to when girls and boys should have separate bedrooms it is reasonable to suggest that an age cut-off before 10 years is desirable.

### **Defining an adult**

It is reasonable that adults should have their own bedroom, but there is no clear definition of adulthood in New Zealand. Markers of adulthood begin at 16 years, when a person can marry (with parental consent) and give consent to sexual intercourse. However, parents are still considered legally responsible for people aged 16 and 17 (unless the young person is married). In contrast, an 18-year-old is "legally independent of parents, could work for the minimum wage immediately, vote and stand in local and general elections, buy and use alcohol and cigarettes, enter contracts, and open cheque and credit accounts"(Te Ara, 'defining childhood').

Under New Zealand's child support system, parents are required to provide financial support for their children until they are 19 years, unless the young person is married, working full-time, or accessing a benefit or student allowance (Inland Revenue, 'defining child support'). Under the law, 20 years is the age of majority according to statute (Age of Majority Act, 1970).

Age 18 years is the most common definition of adulthood in New Zealand. Urry (nd) concluded that 18 was a reasonable approximation of adulthood "at 18, young people can vote and in this sense become citizens of the nation state, the supreme social category and grouping beyond that of the family headed by their parent(s)".

There was little support for defining adulthood by the traditional age of 21 years (the age cut-off suggested by the BBS index) even in the UK. The UK's [poverty.org](http://poverty.org) website rates the adequacy of this indicator as limited "the bedroom standard itself is considered by many to be low, particularly for those aged between 10 and 21".

Allocating a bedroom for each child 10 and over results in many more households being defined as crowded. As figure 23 showed, when an experimental index that allocated a bedroom to everyone who was not a couple, regardless of age, was added, bedroom sharing did decline. The decline was slow from nine years, but sharing was still very common until about 14 or 15 years, before declining more sharply from 18 years. The CNOS index, with its 18-years threshold, appears closest to the cultural and legal norms in New Zealand.

## 6 Discussion

This chapter reviews the evidence from this paper and recommends the adoption of the Canadian National Occupancy Standard.

In chapter 3's methodology section, criteria to assess which crowding index worked best in the New Zealand context were established. These criteria included: availability and quality of data, effectiveness of the index to identify crowded households, and appropriateness of the index to New Zealand's cultural norms. This research also involved discussions with interested agencies, particularly Wellington School of Medicine and Housing New Zealand. Interim results were presented and discussed with these groups.

Table 14 provides a quick reference on how each index performs against the main assessment criteria.

**Table 14**  
**Assessment criteria for crowding indexes**

Assessment criteria	Index			
	ACI/PPR	BBS	CNOS	ECI
Data				
Data requirements	Rooms, number of usual residents	Bedrooms, age, sex, couple status	Bedrooms, age, sex, couple status	Bedrooms, age, sex, couple status
Data availability from census	Data not available in 1986. Not fit for purpose in 1991	Available	Available	Available
Data quality	Considered fit for purpose but quality of data poorer than bedroom data	Fit for purpose	Fit for purpose	Fit for purpose
Time series	From 1996 onwards	Can be calculated from 1986	Can be calculated from 1986	Can be calculated from 1986
Effectiveness of indexes				
Effectively identifies crowded households	Yes – but higher proportion of misclassified households due to poorer quality of rooms data when compared with bedroom data	Yes	Yes	Yes – but includes many more households as crowded so difference not as marked

Table 14 continued next page

Table 14 continued

Assessment criteria	Index			
	ACI/PPR	BBS	CNOS	ECI
Effectiveness of indexes				
Does index give a range of information	Yes – crowded, severely crowded, not crowded. Further categories can be generated	Yes – but no severe crowding category. Further categories can be generated	Yes – has widest range from severe crowding to underutilisation	Crowded/not crowded. Further categories can be generated but work better if recalculated as a difference measure
Appropriateness for different ethnic groups	Good	Good	Good	Identifies many more European households as crowded
Effective at small area level	Slightly poorer (data quality)	Good	Good	Good
Which index was the best fit culturally?				
Use age criteria	No	Yes	Yes	Yes
Alignment with age of puberty	N/A	Age threshold possibly too high (10 years and over)	Better fit but age threshold maybe too low (5 years)	Age threshold possibly too high (10 years and over)
Alignment with age of adulthood	N/A	Too old (21 years)	Best fit	No – all children 10 and over given own room

**Key**

<b>Worst fit</b>		<b>Best fit</b>
------------------	--	-----------------

**Summary of results**

The results presented in this paper show that the number of crowded households varies sharply depending on which crowding index is used. Therefore, the index selected will influence public perceptions about the extent of crowding in New Zealand.

According to the ACI, 37,488 households (2.7 percent) and 228,786 people (5.9 percent of people in households) were defined as crowded. Compared with the ACI, the ECI identified 2.5 times as many households as crowded (95,394 households or 6.9 percent) and 2.3 times as many people (516,900 people or 13.3 percent). Given this variation in numbers, which index works best in the New Zealand context when assessed against the three assessment criteria?

## **Data availability**

The four indexes considered in this paper were chosen because they could be calculated from existing data sources – variables available from the Census of Population and Dwellings. Other indexes were discarded because suitable data was not available, while a fourth index (the Occupancy Rating System) was not included as it seemed unnecessarily complex.

## **Data quality and reliability is superior for indexes based on bedrooms**

Data quality is not as good under the ACI, because respondents have difficulty when counting the number of rooms. It is likely that one-quarter of households may be misclassified as crowded under the ACI because of issues with number-of-rooms data. While some differences between the ACI and bedroom indexes are definitional (eg ACI includes couple-only households) much of the difference is due to data quality. The bedroom indexes have an advantage – the data they are based on is slightly better quality and these indexes have a longer time series.

## **Effectiveness of indexes to identify and delineate differences between crowded and non-crowded populations**

The literature discussion identified distinctive characteristics associated with crowded households. New Zealand data was expected to present similar results – this expectation was fulfilled.

All four indexes distinguished crowded households as sharing distinctive characteristics that were very different from New Zealand households in general. Crowded households were much larger on average, had much lower rates of home ownership, had higher rates of government income support, and were more likely to consist of more than one family (six to 10 times the national average). Crowding was strongly associated with the presence of dependent children in a household. Less than 2 percent of households without dependent children experienced crowding but around 90 percent of households with 10 or more children were crowded. The main difference in characteristics between indexes was in household composition. However, this difference had a relatively small effect on the overall number of households defined as crowded. The ACI identified some couple-only households as crowded (living in one room); under the bedroom-based indexes it is impossible for a couple to be crowded.

While all indexes identified similar crowding characteristics, the ECI showed some important differences. Under the ECI, more one-family-with-children households were crowded, largely because under this index all children over 10 years are entitled to their own room. The ECI showed slightly less socio-economic disparity with total households than other indexes. This suggests the index parameters can affect the number of households that are close to being counted as crowded.

## **Including a range in indexes, from severe crowding to dwelling under-utilisation**

Including a severely crowded category appears to be very useful when a bedroom index is used. Households in this category are distinctive from households requiring just one extra bedroom. The CNOS index provides the most comprehensive range – from a two-or-more-bedroom deficit to two-or-more-bedrooms spare. Extra categories can be calculated for the other bedroom indexes although these are not normally used. Because the ECI is a ratio measure designed to create a simple measure of crowded versus non-crowded, adding a severely crowded category does not work as well as for the difference measures. When the ACI is used, households with a greater room deficit are not as distinctive, possibly because couples are included and the issues with rooms data. This range of information gives context and richness to crowding data and should prove useful for work that attempts to compare crowding with outcomes (eg health research).

## **Indexes' effect on geographical distribution of crowding**

When geographic distribution of crowding was explored the indexes appeared only marginally different, although bedroom indexes were slightly superior at area unit level (probably due to data quality issues for rooms data). Because the differences were small, deciding which crowding index to use when looking at geographical distribution will depend on the researcher's preference.

## **Appropriateness of indexes for New Zealand's cultural norms**

Did indexes align with cultural attitudes to space utilisation within different ethnic groups, and did indexes affect the distribution of crowding by ethnicity?

There is not a perfect agreement about what constitutes crowding but the idea of boys and girls being allocated separate bedrooms (especially after puberty) aligned comfortably with social norms in New Zealand. The main issue was that much of New Zealand's housing stock was inappropriate for larger households that are more common among people with Māori and Pacific ethnicity. The literature clearly shows that crowding has detrimental effects, regardless of cultural attitudes towards how space is used within a household.

When the ethnic distribution of crowding was examined for this paper, concerns of ethnic bias towards Pacific people were largely unfounded. The ECI identified almost four times more people with European ethnicity as crowded than the ACI did, but only 1.6 times as many Pacific people as the ACI. Household characteristics that may be more common among some ethnic groups (eg multiple families living together) appear the most important factor in defining a household as crowded. Not surprisingly, the higher the number of dependent children and total people in a household, the greater the proportion of households defined as crowded.

## **Index that best fits social norms in New Zealand**

Of all the bedroom indexes, the CNOS provides a reasonable fit if just one figure is required. It approximates ideas of independence in New Zealand (eg that people over 18 years should have their own bedroom) more closely than the BBS (young people are allocated their own room at 21 years). The ECI requirements would be difficult to meet for large families (children over 10 years are allocated their own bedroom). This index was also more problematic when used with variables such as age or ethnicity.

The researcher's preference and the topic researched will help determine which crowding index to use, noting the issues above. However, because age is a factor when calculating the crowding indexes based on bedrooms, the age thresholds used affect the age distribution of crowding, particularly for children.

If the effects of crowding on education are being researched, one can argue that children might require a private space to study, in which case the ECI might be a more appropriate index to use.

## **Conclusions and recommendations for further research**

The main finding of this paper is that while all four indexes distinguished crowded households, the CNOS index provided the 'best fit' for the New Zealand context. Yet it may be useful to provide information about crowding from more than one index; for example, to enable comparisons with Australia, Canada, or the UK. Since the ACI is widely used it is worthwhile to give this index as well, but to keep in mind the data issues that limit its quality.

This paper has examined how well the indexes identified characteristics that, from the literature, would be expected to be associated with crowded housing. It was expected that people living in crowded households would tend to come from backgrounds of socio-economic disadvantage, and be more concentrated among ethnic minorities. This supposition was supported by analysing New Zealand census data for each index

investigated. Space utilisation information (rather than just crowding) provided further useful information.

Severe crowding was associated with the greatest socio-economic disadvantage and bedroom underutilisation was associated with socio-economic advantage. It was not possible to compare different indexes with outcomes such as infectious disease rates. This information was not available in the dataset. Further analysis of the relationship between different crowding indexes and other variables might provide useful information on how crowding indexes relate to outcomes. It would also be useful to study the effects of the severity of crowding on physical and mental health and on educational attainment.

## 7 References

- Auckland Regional Public Health Service (2005). *Housing and health in Auckland. A summary of selected research*. Auckland, New Zealand.
- Australian Bureau of Statistics (ABS) (2008). *Socio-economic indexes for areas (SEIFA)*. (Technical Paper 2006). Australia: ABS.
- ABS (2007). Housing occupancy and costs, Australia, 2005-06. Available from <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4130.0.55.001Main+Features12005-06?OpenDocument> (accessed July 2010).
- ABS (1996). *Housing stock: Aboriginal and Torres Strait Islander housing in non-remote areas*. *Australian Social Trends*. Available from [www.abs.gov.au/ausstats](http://www.abs.gov.au/ausstats) (accessed April 2010).
- ARP Institute (2005). *Context for housing policy since 1975*. (Statistical Time Series with Commentary), Washington.
- Baker, M (2007). Household crowding an avoidable health risk. *Build*, 36–37.
- Baker, M, McNicholas, A, Garrett, N, Jones, N, Stewart, J, Koberstein, V, & Lennon, D (2000). Household crowding a major risk factor for epidemic meningococcal disease in Auckland children. *Journal of Pediatric Infectious Diseases*, 19(10), 983–90.
- Baker, M, Das, D, Venugopal, K & Howden-Chapman, P (2008). Tuberculosis associated with household crowding in a developed country. *Journal of Epidemiology and Community Health*, 62, 715–21.
- Baker, M, Goodyear, R, & Howden-Chapman, P (2003). Household crowding and health. In Statistics New Zealand, *What is the extent of crowding in New Zealand? An analysis of crowding in New Zealand households 1986–2001*.
- Baker, M, Zhang, J, Howden-Chapman, P, Blakely, T, Saville-Smith, K, & Crane, J (2006). *Housing, crowding and health study: Characteristics of cohort members and their hospitalisations February 2003 to June 2005*. Interim report, He Kainga Oranga/Housing and Health Research Programme.
- Beggs, P (1999). *Spatial analysis of dwelling crowding and disease in Sydney, Australia*. Presented at SIRC 99 – The 11th Annual Colloquium of the Spatial Information Research Centre, University of Otago, Dunedin, New Zealand.
- Booth, A, & Cowell, J (1976). Crowding and health. *Journal of Health and Social Behaviour*, 17(3), 204–20.
- Booth, A, Johnson, DR, & Edwards, JN (1980). In pursuit of pathology: The effects of human crowding. *American Sociological Review*, 45(5), 873–78.
- Buckett NR (Ed), Marston, NJ (Ed), Saville-Smith, K, Jovett, JH and Jones, MS, *Study Report SR240 (2011) Preliminary Branz 2010 House Condition Survey Report*, 2nd ed.
- Canada Mortgage and Housing Corporation (2009). *Extended characterization of individuals experiencing occasional and persistent core housing need (2002–04)*. (Research Highlight, Socio-economic series 09-019).
- Canadian Tuberculosis Committee (2007). *Housing conditions that serve as risk factors for tuberculosis infection and disease*. *Canada Communicable Disease Report*, 33(9).

- Cardoso, M, Cousens, de G, Siqueira, L, Alves, F, & D'Angelo, L (2004). Crowding: risk factor or protective factor for lower respiratory disease in young children? *BMC Public Health*. 4(19). Available from [www.phac-aspc.gc.ca](http://www.phac-aspc.gc.ca)
- Census and Statistics Office (1924), Results of a Census of the Dominion of New Zealand taken for the night of the 17th April, 1921, Part XV. Dwellings. Wellington.
- Chambers, S, & Baker, M (2004). Infectious diseases – far from defeated. *The New Zealand Medical Journal*, 117(1,200).
- Changemakers Refugee Forum (2011). *Barriers to achieving good health outcomes in refugee-background communities*. Report prepared for Regional Public Health and the Department of Labour, New Zealand.
- Children's Commission (Spring 2008). Child poverty in New Zealand. *Children* (special edition), Wellington.
- Cookson, A, & Sillet, J (September 2009). *Room to move*. Local Government Information unit, City of Westminster, England.
- Conley, D (2001). A room with a view or a room of one's own? Housing and Social Stratification, *Sociological Forum*, 16(2).
- Evans, GW, Ricciuti, HN, Hope, S, Schoon, I, Bradley, RH, Corwyn, RF, & Hazan, C (2010). Crowding and cognitive development: The mediating role of maternal responsiveness among 36-month-old children. *Environment and Behavior*, 42(1), 135–48.
- First Nations Centre (2006). *Report on first nations' housing*. First Nations Regional Longitudinal Health Survey (RHS) 2002/03.
- Fuller, T, Edwards J, Sermsri, S, & Vorakitphokatorn, S (1993). Housing, stress, and physical well-being: Evidence from Thailand. *Social Science and Medicine*, 36(11), 1,417–28.
- Gove, W, & Hughes, M (1980). The effects of crowding found in the Toronto study: Some methodological and empirical questions, *American Sociological Review*, 45(5), 864–70.
- Gray, A (2001). *Definitions of crowding and the effects of crowding on health: A literature review*. Prepared for the Ministry of Social Policy, Gray Matter Research Ltd.
- Housing New Zealand (2004). [Ki te hau kainga – new perspectives on Māori housing solutions](http://www.hnzc.co.nz). Available from [www.hnzc.co.nz](http://www.hnzc.co.nz) (accessed November 2011).
- Housing New Zealand (2002). [Pacific housing design guide – the beginning](http://www.hnzc.govt.nz). Available from [www.hnzc.govt.nz](http://www.hnzc.govt.nz)
- Howden-Chapman, P, Crane, J, Matheson, A, Viggers, H, Cunningham, M, Blakely, T, O'Dea, D, Cunningham, C, Woodward, A, Saville-Smith, K, Baker, M, & Waipara, N (In press). Retrofitting houses with insulation to reduce health inequalities: Aims and methods of a clustered, randomised, community-based trial, *Social Science & Medicine*.
- Jensen, J (1988). *Income inequivalencies and the estimation of family expenditures on children*. Unpublished paper, Department of Social Welfare, Wellington.
- Jones, N (2000). *Adolescent and adult household crowding in Auckland – the spatial distribution of a major risk factor for meningococcal disease among under 8-year-old children*. Presented at SIRC 2000 – the 12th Annual Colloquium of the Spatial Information Research Centre University of Otago, Dunedin, New Zealand.

Kjellén, M (2001). Health Division document, OECD: Paris

Kopoko, K (2004). The effects of the physical environment on children's development, Insights for parents, teachers, and educators featuring research by Dr Gary Evans. Outreach and Extension, Department of Human Development, Cornell University. Available at [www.parenting.cit.cornell.edu/documents/Physical-Environment-Evans](http://www.parenting.cit.cornell.edu/documents/Physical-Environment-Evans)

Lepore, SJ, Evans, GW, & Palsane, MN (1991). Social hassles and psychological health in the context of chronic crowding. *Journal of Health and Social Behaviour*, 32(4), 357–67.

London Housing (October 2004). *Overcrowded housing and the effects on London's communities*. Information available at [www.london.gov.uk](http://www.london.gov.uk). See also the London Health Observatory ([www.lho.org.uk](http://www.lho.org.uk)) on [housing](#).

Maani, SA, Vaithianathan, R, & Wolfe, B (2006). *Inequality and health: Is housing crowding the link?* (Motu Working Paper 06–09), Motu Economic and Public Policy Research.

Mill, C, Baker, M, & Tobias, M (2002). A re-appraisal of the burden of infectious disease in New Zealand: aggregate estimates of morbidity and mortality. *The New Zealand Medical Journal*, 115(1,155).

Moller, R, Johnson, H, & Dardia, M (2002). *What explains crowding in California?* California Research Bureau, California State Library.

Morrison, P (1994). Housing occupancy and the changing size of households and dwellings in New Zealand, 1951–1991. *New Zealand Population Review* 20(1&2), 32–64.

Office for National Statistics (December 2009). *Social trends*, Chapter 10: Housing No. 40, [www.ons.gov.uk/ons/search/index.html?pageSize=50&newquery=social+trends+40](http://www.ons.gov.uk/ons/search/index.html?pageSize=50&newquery=social+trends+40) (accessed July 2010).

Office of the Deputy Prime Minister (May 2004). *The impact of overcrowding on health & education: A review of evidence and literature*, London, UK: Office of the Deputy Prime Minister.

Pene, G, Howden-Chapman, P, Peita, M, Vigger, H, & Gray, J (2009). [Living the Tokelauan way in New Zealand – teenagers' perspectives on extended-family living](#). (Report no 3/09), Families Commission. Available from [www.nzfamilies.org.nz](http://www.nzfamilies.org.nz)

Riggs, K (April 2006). Growth spurt, *NZ Listener*, 203(3,438).

Salmond, C, & Crampton, P (2002). *NZDep2001 Index of Deprivation*. Department of Public Health, Wellington School of Medicine and Health Sciences.

Schluter, P, Carter, S, & Kokaua, J (2007). Indices and perception of crowding in Pacific households domicile within Auckland, New Zealand: findings from the Pacific Islands Families Study. *Journal of the New Zealand Medical Association*, 120(1,248).

Shaw, C, Blakely, T, Atkinson, J, & Crampton, P (2005). Do social and economic reforms change socioeconomic inequalities in child mortality? A case study: New Zealand 1981–1999. *Journal of Epidemiology and Community Health*, 59, 638–44.

Solari, C, & Mare, R (draft 2007). *Housing crowding effects on children's wellbeing: national and longitudinal comparisons*. California Center for Population Research. (On-Line Working Paper Series, 2008).

SPEAR bulletin (2006). Housing and health study initial findings. Available from [www.spear.govt.nz](http://www.spear.govt.nz)

Stats Canada (2009). *2006 Census Housing Series: Issue 5\_ Canada's Census Metropolitan Areas (CMAs) Research Highlight*. (Socio-economic series 09-022).

Statistics New Zealand (2008). *Demographic trends: 2007*. Statistics NZ: Wellington.

University of Otago (2009). *Infectious disease classification with a particular focus on close-contact infectious diseases*. Workshop 22 April 2009, Wellington.

Urrey, J (1998). Setting an age for adulthood. [www.victoria.ac.nz/yfp/papers/age.html](http://www.victoria.ac.nz/yfp/papers/age.html) (accessed Nov 2010).

U.S. Census Bureau (2003). *Structural and occupancy characteristics of housing: 2000*. Census 2000 Brief.

U.S. Census Bureau (2002). *Current Housing Reports* (Series H150/01), American Housing Survey for the United States: 2001, U.S. Government Printing Office: Washington DC.

Williams, K (2009). *Space per person in the UK: A review of densities, trends, experiences and optimum levels*. Land Use Policy 26S.

# Appendix 1: 2006 Census questions

## Question from 2006 Census

**14** How many bedrooms are there in this dwelling?

Count

- rooms or sleepouts furnished as bedrooms
- any caravan that this household uses as a bedroom

print number of bedrooms

Number of bedrooms help note in the 2006 Census:

**14** I sleep in the lounge. Does that count as a bedroom?

DON'T count your lounge as a bedroom unless you have no other bedrooms in this dwelling. If your lounge is the only bedroom in this dwelling, then count it and put '1'.

Number of rooms question in the 2006 Census:

**15** Counting those bedrooms, how many rooms are there in this dwelling?

Count open-plan rooms like this: kitchen-lounge-dining is three rooms, kitchen-dining is two rooms.

<p>DON'T count</p> <ul style="list-style-type: none"> <li>• bathrooms, showers, toilets</li> <li>• spa rooms</li> <li>• laundries</li> <li>• halls</li> <li>• garages</li> <li>• pantries</li> </ul>	<p>Count</p> <ul style="list-style-type: none"> <li>• bedrooms</li> <li>• kitchens</li> <li>• dining rooms</li> <li>• lounges or living rooms</li> <li>• rumpus rooms, family rooms, etc</li> <li>• conservatories you can sit in</li> <li>• studies, studios, hobby rooms, etc</li> </ul>
--	--

print number of rooms

## Appendix 2: Crowding measurements

### **1921 Census ('more than 1.5 people per room')**

Crowding was defined as more than 1.5 people per room. According to this measure almost 9 percent of private dwellings were crowded in 1921, which affected nearly 15 percent of the population. This crowding definition matches the severely crowded category in the American Crowding Index and shows that tolerance to crowding has lessened since the early 20th century.

### **The Housing Improvement Regulations, 1947**

The crowding definition in the Housing Improvement Regulations is still New Zealand's only official definition of crowding. These regulations specify an approved number of people per bedroom, taking into account their age, sex, and relationship (and bedroom size). The regulations also specify the number of bathrooms and toilets needed for the size of household. These regulations make a precise measure of what constitutes crowding possible and can be applied on a case-by-case basis. However, because the census does not collect information about bedroom size and bathrooms, this measure cannot be used to measure crowding levels.

### **Other measures used internationally**

#### **People per floor area**

The United Nations (UN) and the World Bank developed the 'floor area per person' indicator, which is the median usable living space per person. It is calculated by dividing the median floor area of housing in a region by the average household size in that region.

The UN notes that care should be taken with interpreting this indicator and it should be used with related UN indicators. The floor area per person indicator has limitations results may vary considerably depending on the geographic level at which it is calculated (eg at the city, national, or urban/rural levels). Also, the type of information produced differs from that produced by crowding measures calculated on unit record data. Effectively it is a scale of average regional crowding, based on average living space per person, rather than a measure of actual household crowding.

The floor area per person measure cannot be applied to New Zealand census data as the census does not record floor area.

#### **Occupancy rating system**

The occupancy rating system (ORS) involves a more generous room allocation – it assumes a one-person household requires three rooms (two common rooms and a bedroom). If there are two or more residents, ORS assumes they require a minimum of two common rooms plus one bedroom for couples, and for pairs of children, and allocates an individual bedroom to everyone aged 16 and over. Because this measure is more complex to calculate the BBS was used as the fourth measure for this paper.

#### **Comparability between countries**

Data on crowding that is based on rooms may not be exactly comparable between countries due to small differences in defining rooms. However, approximate comparisons can be made.

The US Census of Housing asks "How many rooms do you have in this house, apartment, or mobile home? Do NOT count bathrooms, porches, balconies, foyers, halls, or half-rooms."

In the 2001 UK Census, 'room' refers to kitchens, living rooms, bedrooms, utility rooms, and studies; and excludes bathrooms, toilets, halls, landings, and rooms that can only be used as storage (eg wardrobes).

In the 2006 New Zealand Census, 'room' refers to kitchens, dining rooms, lounges or living rooms, bedrooms, rumpus or family rooms, studies, and studios or hobby rooms; and excludes bathrooms, showers, toilets, spa-rooms, laundries, halls, garages, and pantries.

## Appendix 3: Revised Jensen Scale and Jensen Equivalised Annual Household Income (JEAH)

Annual household income, derived by summing annual personal income for all household members, provides basic information about household wealth. However, as an indicator of relative standard of living, annual household income is inadequate. For example, a one-adult household with an annual household income of \$35,000 is likely to be able to access a higher standard of living than a household of 10 people with the same income.

To allow comparison of household income across household types, a scale can be used to equivalise annual household income for household composition. Equivalised income is a ranked measure of income. The equivalence scale used in this paper is the RJS,<sup>3</sup> developed by John Jensen of the (then) Department of Social Welfare (Jensen, 1988).

The scale is constructed so that a two-adult household has a rating of 1; households with fewer members score less than 1, those with more score more than 1. The scale also accounts for children being likely to require less income than adults to maintain a similar standard of living. JEAH income is calculated for individual households by reweighting household income to a two-adult household.

For example, a two-adult household with an annual total income \$35,000 will also have a JEAH income of \$35,000, since its Jensen Rating is 1.

If this household included a seven-year-old child, its Jensen Rating would increase to 1.19 and its JEAH would be:

$$\frac{\$35,000}{1.19} = \$29,400 \text{ (rounded to nearest \$100)}$$

## Appendix 4: Distribution of crowding by territorial authority

### Distribution of crowding by territorial authority

2006 Census

Territorial authority	Percent of crowded households			
	CNOS	ACI	BBS	ECI
Far North district	7.9	4.6	6.8	10.4
Whangarei district	4.8	2.5	4.0	6.9
Kaipara district	3.8	2.2	3.1	5.6
Rodney district	2.5	1.2	2.0	4.0
North Shore city	3.8	1.9	3.0	5.0
Waitakere city	7.4	4.2	6.1	9.6
Auckland city	8.9	4.8	7.7	10.2
Manukau city	13.8	8.5	11.7	16.6
Papakura district	8.4	4.6	6.9	10.9
Franklin district	4.2	2.4	3.4	6.4
Thames-Coromandel district	2.9	1.8	2.3	4.1
Hauraki district	3.6	1.9	3.0	5.6
Waikato district	5.7	2.9	4.7	8.0
Matamata-Piako district	3.1	2.0	2.6	5.1
Hamilton city	6.0	2.8	4.8	7.8
Waipa district	2.8	1.2	2.1	4.5
Otorohanga district	4.1	2.6	3.5	6.4
South Waikato district	5.5	3.5	4.2	8.1
Waitomo district	6.1	3.7	5.1	8.4
Taupo district	4.8	2.4	3.9	6.6
Western Bay of Plenty district	4.0	2.2	3.3	5.6
Tauranga city	3.5	1.7	2.7	4.8
Rotorua district	6.3	3.2	5.2	8.6
Whakatane district	7.2	4.3	6.3	9.8
Kawerau district	8.6	4.9	7.3	11.9
Opotiki district	9.8	5.5	8.4	12.9
Gisborne district	7.8	4.2	6.5	10.7
Wairoa district	7.8	4.2	6.6	10.3
Hastings district	6.0	3.0	4.9	8.0
Napier city	4.0	1.7	3.2	5.7
Central Hawke's Bay district	3.3	1.6	2.7	5.5
New Plymouth district	2.9	1.2	2.3	4.6
Stratford district	2.3	1.6	1.7	4.6
South Taranaki district	3.2	1.7	2.5	5.4
Ruapehu district	5.2	3.2	4.2	8.1
Wanganui district	3.7	1.8	3.0	5.7
Rangitikei district	3.1	1.8	2.4	4.9
Manawatu district	2.4	1.4	1.8	4.1
Palmerston North city	3.3	1.4	2.5	4.8
Tararua district	3.0	1.6	2.4	5.1
Horowhenua district	3.5	1.9	2.9	5.3
Kapiti Coast district	2.1	0.8	1.6	3.2
Porirua city	8.9	4.8	7.3	11.6
Upper Hutt city	3.3	1.5	2.5	4.9
Lower Hutt city	6.1	3.0	5.0	8.0
Wellington city	4.4	1.8	3.6	5.3
Masterton district	3.1	1.5	2.4	4.8
Carterton district	2.0	0.7	1.7	3.8
South Wairarapa district	1.7	0.7	1.2	3.3

Table continued next page

Table continued

Territorial authority	Percent of crowded households			
	CNOS	ACI	BBS	ECI
Tasman district	2.6	1.5	2.0	3.9
Nelson city	2.7	1.2	2.0	4.1
Marlborough district	2.7	1.3	2.2	4.0
Kaikoura district	3.2	2.2	2.5	4.7
Buller district	1.8	1.2	1.5	3.2
Grey district	2.3	1.3	1.7	3.9
Westland district	2.2	1.3	1.7	3.9
Hurunui district	1.6	0.8	1.1	2.8
Waimakariri district	1.9	1.3	1.4	3.4
Christchurch city	3.5	1.4	2.7	4.7
Selwyn district	1.6	0.8	1.2	2.9
Ashburton district	1.7	1.1	1.2	3.0
Timaru district	1.5	0.7	1.0	2.7
Mackenzie district	1.7	0.4	1.1	2.8
Waimate district	1.1	0.7	0.7	2.5
Chatham Islands territory	1.8	1.3	1.3	4.0
Waitaki district	1.2	1.0	0.9	2.6
Central Otago district	1.4	0.9	1.0	2.4
Queenstown-Lakes district	3.0	1.8	2.5	3.6
Dunedin city	2.5	0.9	1.8	3.8
Clutha district	1.5	1.1	1.1	3.5
Southland district	1.4	1.1	1.1	3.2
Gore district	1.5	1.0	1.1	3.4
Invercargill city	2.4	1.0	1.8	4.0
Area outside territorial authority	4.8	5.6	4.0	4.8
<b>New Zealand</b>	<b>5.2</b>	<b>2.7</b>	<b>4.2</b>	<b>6.9</b>

Source: Statistics New Zealand