



## Problems with damp and cold housing among Pacific families in New Zealand

Sarnia Butler, Maynard Williams, Colin Tukuitonga and Janis Paterson

### Abstract

**Aims** To describe reported problems with damp and cold housing among Pacific families in New Zealand and their associations with two facets of maternal health, namely postnatal depression and asthma.

**Methods** The data were gathered as part of the Pacific Islands Families: First Two Years of Life (PIF) Study in which 1376 mothers were interviewed when their infants were six weeks old. Mothers were questioned with regard to problems with dampness or mould and cold housing, facets of maternal health (assessed using the Edinburgh Postnatal Depression Scale), and asthma.

**Results** Over one third of the mothers (37%) reported that their homes had dampness/mould problems, and over half reported problems with cold housing (53.8%). Damp and cold housing were significantly associated with a number of variables including large household size, state rental housing, and financial difficulty with housing costs. Damp and cold housing were also both significantly related to maternal depression and incidence of asthma.

**Conclusions** Efforts to reduce problems with damp and cold housing are needed to improve maternal health. To this end, advice regarding the importance of home heating and ventilation may be beneficial.

Several studies have shown that exposure to damp, mouldy and cold housing can significantly increase the risk of a number of respiratory symptoms including the common cold and asthma, in addition to non-respiratory problems such as fatigue and poor concentration.<sup>1-5</sup> However, the link between poor housing and mental health is not as well documented as the association with physical health.

A study by Kearns, Smith and Abbott highlighted that Pacific households reported living in worse housing than Maori or European households.<sup>6</sup> Pacific people were also more likely than other groups to have symptoms of asthma, colds and flu. The authors acknowledged that other social and economic deprivation factors were likely to be operating in conjunction with housing issues to contribute to the health problems reported.<sup>6</sup> Other research supports the association between deprivation, ethnicity and health, with the prevalence rates of asthma being higher in more deprived regions of the country and higher in Maori and Pacific adults than other New Zealanders.<sup>7</sup> Tukuitonga proposed that poor housing conditions coupled with inadequate nutrition and a sedentary lifestyle have contributed to many of the health problems experienced by Pacific peoples.<sup>8</sup>

In view of the concern about poor health and housing conditions faced by many Pacific families, questions examining housing problems were included in the first assessment of the Pacific Islands Families: First Two Years of Life (PIF) Study. The

purpose of the present study was to examine problems with dampness/mould and cold housing and any associations with postnatal depression and asthma among mothers of the PIF cohort.

## Methods

Data were collected as part of the PIF Study, a longitudinal investigation of a cohort of 1398 infants born at Middlemore Hospital, South Auckland, during the year 2000. Middlemore Hospital has the largest number of Pacific births in New Zealand and its patient population is representative of the major Pacific ethnicities. All potential child participants were selected from live births at Middlemore Hospital where the child had at least one parent who identified as being of a Pacific Island ethnicity and also a New Zealand permanent resident. All procedures and interview protocols had ethical approval from the National Ethics Committee.

Approximately six weeks after the birth of their child, the mothers were visited in their homes by Pacific interviewers, fluent in both English and a Pacific language. Once eligibility criteria were confirmed and informed consent was gained, mothers participated in one-hour interviews concerning the health and development of the child and family functioning. These interviews were carried out in the preferred language of the mothers. Detailed information about the cohort and procedures is described elsewhere.<sup>9</sup>

As part of the interview protocol, mothers were asked to what extent ('not at all', 'to some extent', 'a great deal') their homes had problems with dampness/mould and cold. Postnatal depression was assessed with the Edinburgh Postnatal Depression Scale (EPDS), a self-report instrument for which a score above 12 is widely used to indicate probable depressive disorder.<sup>10</sup> The reliability coefficient of the EPDS for biological mothers in the PIF Study was 0.86. Mothers were also asked whether they had any of a range of health problems, including asthma that had been diagnosed by a doctor or for which the mother was currently taking medications.

Maternal and socio-demographic factors expected to influence reports of dampness/mould and cold housing problems, and relationships between these problems and depression and asthma, were assessed by univariate and multivariate logistic regression procedures.

## Results

The cohort was made up of 87.1% of all eligible Pacific births that occurred in the period from 15 March to 17 December 2000. Of the 1376 mothers of the cohort (1.7% gave birth to twins), 47.2% self-identified their major ethnic group as Samoan, 21% as Tongan, 16.9% as Cook Islands Maori, 4.3% as Niuean, 3.4% as Other Pacific (includes mothers identifying equally with two or more Pacific groups, equally with Pacific and non-Pacific groups, or with Pacific groups other than Samoan, Tongan, Cook Island or Niuean), and 7.2% as non-Pacific. The mean (SD) age of mothers was 27 (6.2) years; 80.5% were married or in de facto partnerships; 33% were New Zealand-born; and 27.4% had post-school qualifications.

Problems with housing dampness or mould were reported by 509 (37%) and problems with cold housing by 740 (53.8%) mothers. Since only 376 (27.4%) mothers who reported dampness/mould to be a problem also reported that their homes were cold, the two problems were treated separately in analyses.

Table 1 lists variables examined for potential association with dampness/mould problems. For the categories within each variable the numbers and percentages of mothers who reported dampness/mould problems are shown, along with their respective univariate odds ratio (95% CI).

**Table 1. Numbers and univariate odds ratios (OR) of problems with dampness in the home by selected variables**

Variable Category	n	(% within category)	OR	(95% CI)
<b>Maternal variables</b>				
<b>Age</b>				
<20 years	30	(27.0)	1.00	
20–29 years	263	(36.6)	1.56	(1.00–2.43)
30–39 years	198	(39.7)	1.77	(1.13–2.80) <sup>†</sup>
40+ years	17	(38.6)	1.70	(0.81–3.55)
<b>Born in NZ</b>				
Yes	175	(38.6)	1.00	
No	334	(36.3)	0.91	(0.72–1.14)
<b>Social marital status</b>				
Partnered	419	(38.0)	1.00	
Non-partnered	90	(33.5)	0.82	(0.62–1.09)
<b>Ethnicity</b>				
Samoan	187	(28.8)	1.00	
Cook Island	75	(32.8)	1.21	(0.87–1.67)
Niuean	33	(55.9)	3.14	(1.83–5.40) <sup>‡</sup>
Tongan	142	(49.1)	2.39	(1.80–3.19) <sup>‡</sup>
Other Pacific*	23	(48.9)	2.37	(1.31–4.31) <sup>§</sup>
Non-Pacific	49	(49.5)	2.43	(1.58–3.73) <sup>‡</sup>
<b>Education</b>				
No formal qualifications	186	(34.8)	1.00	
Secondary school qualifications	164	(35.4)	1.03	(0.79–1.33)
Post-school qualifications	159	(42.3)	1.37	(1.05–1.80) <sup>†</sup>
<b>English fluency</b>				
No	188	(35.9)	1.00	
Yes	321	(37.8)	1.08	(0.86–1.36)
<b>Years in NZ</b>				
0–2	27	(26.5)	1.00	
3–5	61	(35.9)	1.55	(0.91–2.66)
6–10	55	(37.4)	1.66	(0.96–2.88)
>10	365	(38.4)	1.73	(1.09–2.73) <sup>†</sup>
<b>Cultural alignment</b>				
Low NZ low Pacific	91	(36.8)	1.00	
High NZ low Pacific	176	(40.5)	1.17	(0.84–1.61)
Low NZ high Pacific	162	(36.2)	0.97	(0.71–1.35)
High NZ high Pacific	75	(32.2)	0.81	(0.56–1.19)
<b>Other variables</b>				
<b>Household income (annual)</b>				
>\$40 000	67	(41.6)	1.00	
\$20 001–40 000	269	(38.0)	0.86	(0.61–1.22)
\$0–20 000	157	(34.4)	0.73	(0.51–1.06)
Unknown	16	(34.0)	0.72	(0.37–1.43)
<b>Household size (persons)</b>				
2–4	96	(33.9)	1.00	
5–7	254	(36.7)	1.13	(0.84–1.51)
8 or more	159	(40.2)	1.31	(0.95–1.80)
<b>Housing tenure</b>				
Owned or mortgaged	79	(31.9)	1.00	
Private rental	115	(34.8)	1.14	(0.81–1.62)
State rental	218	(44.6)	1.72	(1.25–2.37) <sup>‡</sup>
Other	97	(31.7)	0.99	(0.69–1.42)

<b>Financial difficulty with housing costs</b>				
No/slight difficulty	364	(32.6)	1.00	
Moderate difficulty	59	(51.3)	2.18	(1.48–3.21) <sup>‡</sup>
Great difficulty	83	(63.8)	3.65	(2.50–5.34) <sup>‡</sup>

\*includes mothers identifying equally with two or more Pacific Island groups, equally with Pacific Island and non Pacific Island groups, or with Pacific Island groups other than Tongan, Samoan, Cook Island Maori or Niuean

<sup>†</sup>p <0.05; <sup>‡</sup>p <0.001; <sup>§</sup>p <0.01

NB: For some variables total participant numbers may be lower than 509 due to missing data.

To adjust for potential confounding effects all variables in Table 1 were simultaneously entered into a multiple logistic regression model. When controlling for the effects of all other variables, factors that were significantly associated with housing dampness or mould problems (p <0.05) were Niuean, Tongan, and non-Pacific ethnicity, a household size of eight or more people, state rental housing, and financial difficulty with housing costs.

Table 2 lists variables examined for potential association with cold housing.

**Table 2. Numbers and univariate odds ratios (OR) of problems with cold in the home by selected variables**

<b>Variable Category</b>	<b>n</b>	<b>(% within category)</b>	<b>OR</b>	<b>(95% CI)</b>
<b>Maternal variables</b>				
<b>Age</b>				
<20 years	47	(42.3)	1.00	
20–29 years	394	(54.8)	1.65	(1.10–2.47)
30–39 years	271	(54.2)	1.61	(1.06–2.44) <sup>†</sup>
40+ years	27	(61.4)	2.16	(1.06–4.42) <sup>†</sup>
<b>Born in NZ</b>				
Yes	220	(48.5)	1.00	
No	520	(56.5)	1.38	(1.10–1.73) <sup>‡</sup>
<b>Social marital status</b>				
Partnered	590	(53.3)	1.00	
Non-partnered	150	(55.8)	1.10	(0.84–1.44)
<b>Ethnicity</b>				
Samoan	379	(58.3)	1.00	
Cook Island	91	(39.4)	0.47	(0.34–0.63) <sup>§</sup>
Niuean	36	(61.0)	1.12	(0.65–1.93)
Tongan	157	(54.3)	0.85	(0.64–1.12)
Other Pacific*	26	(55.3)	0.89	(0.49–1.61)
Non-Pacific	51	(51.5)	0.76	(0.50–1.16)
<b>Education</b>				
No formal qualifications	319	(59.6)	1.00	
Secondary school qualifications	243	(52.5)	0.75	(0.58–0.96) <sup>†</sup>
Post-school qualifications	178	(47.2)	0.61	(0.46–0.79) <sup>§</sup>
<b>English fluency</b>				
No	335	(63.9)	1.00	
Yes	405	(47.6)	0.51	(0.41–0.64) <sup>§</sup>

<b>Years in NZ</b>				
0–2	61	(59.8)	1.00	
3–5	103	(60.6)	1.03	(0.63–1.71)
6–10	82	(55.8)	0.85	(0.51–1.42)
>10	493	(51.7)	0.72	(0.48–1.09)
<b>Cultural alignment</b>				
Low NZ low Pacific	104	(41.9)	1.00	
High NZ low Pacific	214	(49.1)	1.34	(0.98–1.83)
Low NZ high Pacific	300	(67.1)	2.83	(2.05–3.89) <sup>§</sup>
High NZ high Pacific	117	(50.2)	1.40	(0.97–2.00)
<b>Other variables</b>				
<b>Household income (annual)</b>				
>\$40 000	71	(44.1)	1.00	
\$20 001–40 000	383	(54.0)	1.49	(1.06–2.10) <sup>†</sup>
\$0–20 000	265	(58.0)	1.75	(1.22–2.51) <sup>‡</sup>
Unknown	21	(43.8)	0.99	(0.52–1.89)
<b>Household size (persons)</b>				
2–4	141	(49.8)	1.00	
5–7	368	(53.1)	1.14	(0.87–1.50)
8 or more	231	(58.0)	1.39	(1.03–1.89) <sup>†</sup>
<b>Housing tenure</b>				
Owned or mortgaged	108	(43.5)	1.00	
Private rental	182	(55.0)	1.58	(1.14–2.21) <sup>‡</sup>
State rental	296	(60.4)	1.98	(1.45–2.70) <sup>§</sup>
Other	154	(50.3)	1.31	(0.94–1.84)
<b>Financial difficulty with housing costs</b>				
No/slight difficulty	577	(51.6)	1.00	
Moderate difficulty	64	(55.2)	1.15	(0.79–1.70)
Great difficulty	96	(73.8)	2.64	(1.76–3.98) <sup>§</sup>

\*includes mothers identifying equally with two or more Pacific Island groups, equally with Pacific Island and non Pacific Island groups, or with Pacific Island groups other than Tongan, Samoan, Cook Island Maori or Niuean

<sup>†</sup>p <0.05; <sup>‡</sup>p <0.01; <sup>§</sup>p <0.001

NB: For some variables total participant numbers may be lower than 740 due to missing data.

To adjust for potential confounding effects all variables in Table 2 were entered simultaneously into a multiple logistic regression model. When controlling for the effects of all other variables, factors that were significantly associated with cold housing (p <0.05) were mother's age being between 20 and 29 years, a household size of eight or more people, rental housing (state or private), and reporting great financial difficulty with housing costs. The odds of reporting problems with cold housing were significantly reduced for Cook Islands mothers compared with Samoan mothers; mothers with post-school qualifications compared with mothers with no formal qualifications; mothers fluent in English; and mothers who, relative to others in the study, demonstrated lower levels of alignment with both New Zealand and their Pacific cultures.<sup>11</sup>

Ninety nine mothers (7.2%) reported having asthma and 16.3% were identified by the EPDS as being probable cases of depression. In multivariate analyses that controlled for maternal age, ethnicity, education, marital status, birthplace, number of years lived in New Zealand, and household income, damp/mouldy housing was significantly associated (p <0.01) with maternal asthma (adjusted OR = 1.82; 95% CI = 1.18–2.83), and probable depression (p <0.05; adjusted OR = 1.40; 95% CI = 1.02–1.91). Cold housing was also significantly associated (p = 0.02) with asthma (adjusted OR = 1.73;

95% CI = 1.10–2.71) and probable depression ( $p < 0.01$ ; adjusted OR = 1.57; 95% CI = 1.14–2.15).

## Discussion

Thirty seven per cent of mothers reported that their homes were damp. While this figure is in line with international findings that show dampness rates varying from 30–37% in Canada and Great Britain,<sup>1,12</sup> to 60% in Taiwan,<sup>13</sup> it is elevated compared with the 26% dampness rate reported by Auckland public housing applicants in another New Zealand study.<sup>6</sup> Cold housing, reported by 53.8% of our mothers, also appears to be a significant problem. Cold and damp are often related and it is possible that participants who report cold housing are experiencing the combined effects of low temperature and high humidity.<sup>2</sup> While reliance on subjective measures of housing problems used in this study could be criticised on the basis of a lack of precision and an increased risk of reporting bias, several studies have demonstrated that questionnaire methods are a good indicator of the presence of housing problems and that respondents often underestimate the existence of problems in their homes.<sup>14,15</sup>

Several studies have linked damp/mouldy and cold housing with respiratory illness,<sup>1–5</sup> with some studies demonstrating a dose-response relationship and more severe asthma occurring as dampness levels increased.<sup>15</sup> Studies have also found associations between poor housing conditions and mental health.<sup>3,4</sup>

While the effects were small, significant links were found in the present study between cold and damp housing and two facets of maternal health. Multivariate analyses revealed that mothers who reported problems with dampness/mould and cold were at greater risk of having asthma and of having postnatal depression. As many Pacific people do not have a regular general practitioner or use preventive medication,<sup>16</sup> estimates of asthma in the PIF Study are likely to be conservative, especially given that the measurement was based on diagnosis and medication rather than the presence of symptoms.

The underlying mechanisms of how cold and damp housing adversely affect health are not clear. Cold indoor temperatures encourage condensation,<sup>17</sup> and it is known that viruses, bacteria, fungi and dust mites tend to flourish in damp conditions.<sup>18–20</sup> An allergic reaction to fungi or dust mites is believed to be the most likely mechanism for triggering respiratory symptoms, although toxic mechanisms might also play a part.<sup>21,22</sup> Allergen exposure, while associated with asthma, may not have an aetiological role in the development of asthma.<sup>23</sup>

Concerns about the ill effects of damp conditions on the health of household members, a reluctance to host guests to a damp and mouldy home, and the financial burden of property damage may explain emotional distress.<sup>3</sup> However, it is also possible that depressed mothers may be more inclined to report housing problems.

In multivariate analyses, five factors were associated with damp/mouldy housing problems and eight with cold housing. If knowledge of risk factors are to be used to inform prevention efforts, attention should be directed to factors that are amenable to change. In this regard, reducing household size, improving standards of state rental housing and providing high-risk groups with information to minimise dampness and cold housing should be of priority for housing and health agencies working with

Pacific families. Factors that are not amenable to change, such as age and ethnicity, can be used to target specific groups.

A number of authors suggest that a reduction in dampness in the home, such as with the provision of good home heating, would help alleviate symptoms of poor health.<sup>4,15,24</sup> Others advocate increased ventilation, use of dehumidifiers or air conditioning,<sup>25</sup> extraction fans, and good insulation to minimise accumulation of moisture.<sup>26</sup> Specific measures to reduce mould growth and concentrations of house dust mites may also be beneficial, particularly for asthma sufferers. Some solutions are fairly simple while procedures such as installation of insulation come at considerable expense.

As it has been suggested that few New Zealand homes are heated to the recommended temperature range,<sup>27</sup> further research is required to ascertain whether cold and damp housing problems are more endemic among Pacific peoples and the Auckland region or more widespread across New Zealand households. Meanwhile, it is essential to initiate strategies to prevent respiratory disease, as it imposes a high social burden and cost on society.<sup>19</sup>

**Author information:** Sarnia Butler, Research Fellow, Pacific Islands Families: First Two Years of Life Study; Maynard Williams, Senior Research Fellow and Statistician, Faculty of Health Studies, Auckland University of Technology; Colin Tukuitonga, Pacific Health Research Centre, Department of Maori & Pacific Island Health, University of Auckland, and Co-Director, Pacific Islands Families: First Two Years of Life Study, Auckland University of Technology; Janis Paterson, Co-Director, Pacific Islands Families: First Two Years of Life Study, Auckland University of Technology, Auckland.

**Acknowledgements:** The Pacific Islands Families Study is supported by grants awarded from the Foundation for Science, Research and Technology, the Health Research Council of New Zealand and the Maurice and Phyllis Paykel Trust. We thank the families who participated in the Study, the Pacific Peoples Advisory Board, and other members of the PIF research team.

**Correspondence:** Sarnia Butler, Faculty of Health Studies, Auckland University of Technology, Private Bag 92006, Auckland. Fax: (09) 917 9877. email: [sarnia.butler@aut.ac.nz](mailto:sarnia.butler@aut.ac.nz)

## References:

1. Dales RE, Zwanenburg H, Burnett R, Franklin CA. Respiratory health effects of home dampness and molds among Canadian children. *Am J Epidemiol* 1991;134:196–203.
2. Evans J, Hyndman S, Stewart-Brown S, et al. An epidemiological study of the relative importance of damp housing in relation to adult health. *J Epidemiol Community Health* 2000;54:677–86.
3. Hopton JL, Hunt SM. Housing conditions and mental health in a disadvantaged area in Scotland. *J Epidemiol Community Health* 1996;50:56–61.
4. Hyndman SJ Housing dampness and health amongst British Bengalis in east London. *Soc Sci Med* 1990;30:131–41.
5. Koskinen OM, Husman TM, Meklin TM, Nevalainen AI. The relationship between moisture or mould observations in houses and the state of health of their occupants. *Eur Respir J* 1999;14:1363–7.

6. Kearns RA, Smith CJ, Abbott MW. Another day in paradise? Life on the margins in urban New Zealand. *Soc Sci Med* 1991;33:369–79.
7. Salmond C, Crampton P, Hales S, et al. Asthma prevalence and deprivation: a small area analysis. *J Epidemiol Community Health* 1999;53:476–80.
8. Tukuitonga CF, Finau SA. The health of Pacific peoples in New Zealand up to the early 1990s. *Pac Health Dialog* 1997;4:59–67.
9. Paterson J, Tukuitonga CF, Abbott M, et al. The Pacific Islands Families Study: Technical Report Number 1. Auckland: Auckland University of Technology; 2002.
10. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression: Development of the 10-item Edinburgh Postnatal Depression Scale. *Br J Psychiatry* 1987;150:782–6.
11. Berry JW. Acculturation as varieties of adaptation. In: Padilla A, editor. *Acculturation: theory, models and some new findings*. Boulder: Westview; 1980. p. 9–25.
12. Platt SD, Martin CJ, Hunt SM, Lewis CW. Damp housing, mould growth, and symptomatic health state. *BMJ* 1989;298:1673–8.
13. Yang CY, Chiu JF, Chiu HF, Kao WY. Damp housing conditions and respiratory symptoms in primary school children. *Pediatr Pulmonol* 1997;24:73–7.
14. Waegemaekers M, Van Wageningen N, Brunekreef B, Boleij JS. Respiratory symptoms in damp homes. A pilot study. *Allergy* 1989;44:192–8.
15. Williamson IJ, Martin CJ, McGill G, et al. Damp housing and asthma: a case-control study. *Thorax* 1997;52:229–34.
16. Garrett JE, Mulder J, Wong-Toi H. Reasons for racial differences in A & E attendance rates for asthma. *NZ Med J* 1989;102:121–4.
17. Lowry S. Housing and health: temperature and humidity. *BMJ* 1989;299:1326–8.
18. Hopton J, Hunt S. The health effects of improvements to housing: A longitudinal study. *Housing Studies* 1996;11:271–86.
19. Peat JK, Dickerson J, Li J. Effects of damp and mould in the home on respiratory health: a review of the literature. *Allergy* 1998;53:120–8.
20. Tobin RS, Baranowski E, Gilman AP, et al. Significance of fungi in indoor air: report of a working group. *Can J Public Health* 1987;78(Suppl):S1–S14.
21. Flannigan B, McCabe EM, McGarry F. Allergenic and toxigenic micro-organisms in houses. *Soc Appl Bacteriol Symp Ser* 1991;20:61S–73S.
22. Garrett MH, Rayment PR, Hooper MA, et al. Indoor airborne fungal spores, house dampness and associations with environmental factors and respiratory health in children. *Clin Exp Allergy* 1998;28:459–67.
23. Tang ML. Is prevention of childhood asthma possible? Allergens, infections and animals. *Med J Aust* 2002;177 Suppl:S75–7.
24. Kuehr J, Frischer T, Karmaus W, et al. Natural variation in mite antigen density in house dust and relationship to residential factors. *Clin Exp Allergy* 1994;24:229–37.
25. Platts-Mills TAE, de-Weck AL. Dust mite allergens and asthma - A worldwide problem. *J Allergy Clin Immunol* 1989;83:416–27.
26. Institution of Environmental Health Officers. Mould fungal spores, their effects on health, and the control, prevention and treatment of mould growth in dwellings. In: *Environmental health professional practice, volume I*. London: Institution of Environmental Health Officers; 1985. p. 1–16.
27. Isaacs N, Donn M. Health and housing – seasonality in New Zealand mortality. *Aust J Public Health* 1993;17:68–70.