Lara Rangiwhetu, Nevil Pierse, Helen Viggers and Philippa Howden-Chapman

Cold New Zealand Council Housing Getting an Upgrade

Abstract

As people spend most of their time at home, residential thermal conditions are important. Central government debate about minimum temperature requirements for rental properties requires an evidence base of indoor temperature data. We collected temperature, humidity and energy data from 49 council housing dwellings in Wellington over winter, and self-reported thermal comfort and heating behaviour. Mean indoor temperature was 14.9°C, colder than the national average, with 67% of readings under 16°C, which the World Health Organization associates with health implications. With New Zealand's high rate of excess winter mortality and children hospitalised for housing-related diseases, cold housing should be addressed.

Keywords temperature, thermal comfort, building performance, energy use, public health, council housing

Lara Rangiwhetu is a PhD candidate with He Kainga Oranga evaluating social housing regeneration. Corresponding author: email lara.rangiwhetu@postgrad.otago.ac.nz. **Nevil Pierse** is a statistician and Deputy Director of He Kainga Oranga. **Helen Viggers** is a research fellow with He Kainga Oranga; her work focuses on the reasons for New Zealand's cold housing. **Philippa Howden-Chapman** is the Director of He Kainga Oranga and Professor of Public Health at the University of Otago, Wellington.

New Zealand housing is cold. New Zealand houses are often poorly constructed and heated, and indoor temperatures tend to be colder than 18°C, the World Health Organization's (WHO) recommended minimum (Howden-Chapman, Viggers et al., 2009). In other temperate countries, such as the United Kingdom, 91% of homes have central heating, compared to only 5% of New Zealand homes (Isaacs et al., 2010). In the latest New Zealand national study, conducted in 1999–2005, the mean living room temperature recorded was 15.8°C during the day in winter (ibid.). In the evening, average living room temperature rose to 17.8°C, but this is still below the recommended minimum level. Typically, rental housing is in worse condition than owner-occupied houses (White et al., 2017).

Household temperature is a topical issue in New Zealand politics. In 2016 the Labour Party's Healthy Homes Guarantee Bill (No 2) proposed a set minimum indoor temperature for all rental properties, and a number of councils are undertaking a

Table 1: Impact of Temperature on Health

Indoor temperature	Effect
21°C	People suffering from Chronic Obstructive Pulmonary Disease should maintain temperatures at this level for at least 9 hours to avoid deteriorating health
20°C	To prevent health risks in the elderly and the very young a 1987 WHO report recommended this minimum temperature
18°C	To prevent health risks in the general population, WHO has recommended this as a minimum indoor temperature since 1982
Under 16°C	Resistance to respiratory diseases may be diminished
6 – 12°C	Blood pressure rises and increases risk of cardio-vascular disease

*Information sourced from Ormandy and Ezratty (2012)

quasi-experimental study with researchers to introduce a rental warrant of fitness (Telfar-Barnard et al., 2017). Despite this, little has been published on indoor temperature measurements in New Zealand homes to inform the policy debate.

To the authors' knowledge only two national studies on residential temperature have been completed, the 1971/72 Household Electricity Survey and the Household Energy End-use Project (HEEP) conducted between 1999 and 2005 (Isaacs et al., 2010). Eight more concentrated studies which utilise temperature measurements are listed below by date of data collection:

- nearly 1,350 homes in eight communities, from the North and South Islands, in 2001 and 2002 (Howden-Chapman, Matheson et al., 2007);
- 111 state housing upgrades in Dunedin, Invercargill and Gore in 2003 and 2004 (Lloyd and Callau, 2006);
- 40 low-income private rentals in Dunedin in 2004 (Povey and Harris, 2005);
- 409 homes in Porirua, Hutt Valley, Christchurch, Dunedin and Bluff in 2006 (Howden-Chapman, Pierse et al., 2008; Pierse et al., 2013);
- nine homes in Papakowhai and Wellington between 2006 and 2008 (Burgess et al., 2008);
- 500 homes in Whanganui, Wellington and Christchurch between 2010 and 2012 (Viggers et al., 2013);
- 15 homes in Auckland, Palmerston North and Dunedin in 2011 and 2012 (Rosemeier, 2014);
- five upgraded council houses in Wellington in 2015 (Rangiwhetu, Pierse and Howden-Chapman, 2017).

There is growing evidence of cold housing increasing health risks, and international guidelines are currently being finalised by the WHO (Telfar-Barnard et al., 2017). Increased risk of respiratory and cardiovascular disease is associated with low indoor temperatures (see Table 1). In New Zealand, 42,000 children are hospitalised annually with housing-related diseases (Hansard, 2016a). According to Davie et al. (2007), New Zealand also has one of the highest excess mortality rates in the world. The excess winter mortality (EWM) phenomenon is where a greater proportion of deaths occur in winter compared to summer. New Zealand data shows excess hospital admissions in winter for those with lower household income and in certain housing types (Hales et al., 2012; Telfar-Barnard, Baker and Hales, 2008). In comparison, when outdoor temperature dropped below –20.0°C in Siberia the average indoor temperature was noted to be 19.6°, and no evidence of overall EWM was found (Donaldson et al., 1998).

In New Zealand, those of lower socio-economic status are more vulnerable to most health effects (Taptiklis and Phipps, 2017). On average New Zealanders spend 70% of their time at home indoors, with vulnerable populations (such as babies, the elderly and those on low incomes) spending up to 90% of their time at home (Baker et al., 2007), making them even more susceptible to housing-related health risks. Fuel poverty, where a household spends more than 10% of its income on energy, is recognised as an issue for a substantial proportion of New Zealand households, and further exacerbates potential health issues for low-income households (Howden-Chapman, Viggers et al., 2012; Statistics New Zealand, 2017). Therefore, it is particularly important to investigate low-income housing conditions, specifically temperatures and tenants' thermal comfort in social housing.

Background to the research

Wellington City Council, with co-funding from central government, has undertaken to upgrade its council housing (Stitt, 2013). An assessment of the council's housing in 2006 found moisture problems in dwellings in Arlington, the largest council housing complex, and tenants complained of being cold.

Arlington is the focus of our study. Stage one of the complex was built between 1971 and 1976, and the final stage was completed between 1981 and 1984. Before the upgrade began there were 269 dwellings on the site: 75 apartments in a high-rise tower, 172 medium-density apartments, two apartments above the community house and 20 townhouses, ranging in size from studios to five-bedroom dwellings. This differs from the average New Zealand home, which is a stand-alone house.

Arlington's redevelopment commenced in 2016. At least one section has been demolished and will be rebuilt to create 'warm, healthy and efficient housing' with the aim of 'safeguard[ing] people from illness caused by low temperature and high moisture levels' (Wellington City Council, 2016, pp.21, 92). The council's *City Housing Design Guide* states that a heater is to be provided in each living space, with a target indoor temperature of 16–19°C. Insulation, double glazing and curtains will be installed to increase thermal performance and mechanical/forced ventilation in bathrooms and kitchens to reduce dampness.

The intervention provided an opportunity to investigate the temperature of the dwellings and the upgrade's impact. This article looks at the condition of the housing before the upgrade.

The research

Objectives

The objectives of this research were to:

1. determine indoor temperatures at Arlington and contribute to indoor temperature data for New Zealand;
2. provide a baseline for understanding the impact of upgraded dwellings;

3. look at how temperatures compared with New Zealand homes and WHO recommendations.

Method

We surveyed tenants about the warmth of their home and monitored temperature, humidity and energy usage of dwellings. Heating, house age, thermal insulation and outdoor temperatures influence indoor temperatures and were taken into consideration (French et al., 2006; Giancola et al., 2014; Howden-Chapman, Matheson et al., 2007). We intend to collect follow-up data after the upgrade.

Recruitment

A list of eligible dwellings was provided by the landlord, City Housing. The research was introduced to tenants at a community meeting and in a tenant newsletter. The study was fully explained to tenants when recruiting participants via door knocking and an information sheet was provided.

Sample

The study's inclusion criteria were Arlington tenants willing to answer a face-to-face survey and allow temperature monitoring of their dwelling. Viable temperature data were collected from 49 dwellings. Seventy-eight tenants, over the age of 16, who lived in these dwellings completed face-to-face surveys about indoor thermal comfort.

Temperature and humidity measurement

Ibuttons and HOBO data loggers were installed in participants' homes over the winter months, June, July and August 2015. These are small, robust data loggers, programmed to record temperature and humidity every hour within ±0.5°C and ±5.0% RH accuracy (Maxim Integrated, 2014; OneTemp, 2015).

In total 124 data loggers were installed, typically in the living room and the main bedroom. If children were living in the dwelling a third data logger was placed in the youngest child's room. In studios, only one data logger was placed in the main room. One hundred and two data loggers produced viable results from 49 dwellings. Other data loggers were lost, had been moved, or the tenants had moved out. Two were faulty.

Table 2: Temperature Readings Compared to WHO Recommendations

Readings	Proportion of time	Percentage of dwellings that experienced these temperatures
Less than 10ºC	1%	20%
Less than 12ºC	9%	73%
Less than 14ºC	33%	94%
Less than 16ºC	67%	98%
Less than 18ºC	87%	100%
Less than 21ºC	97%	100%

Figure 1: Distribution of living room temperatures

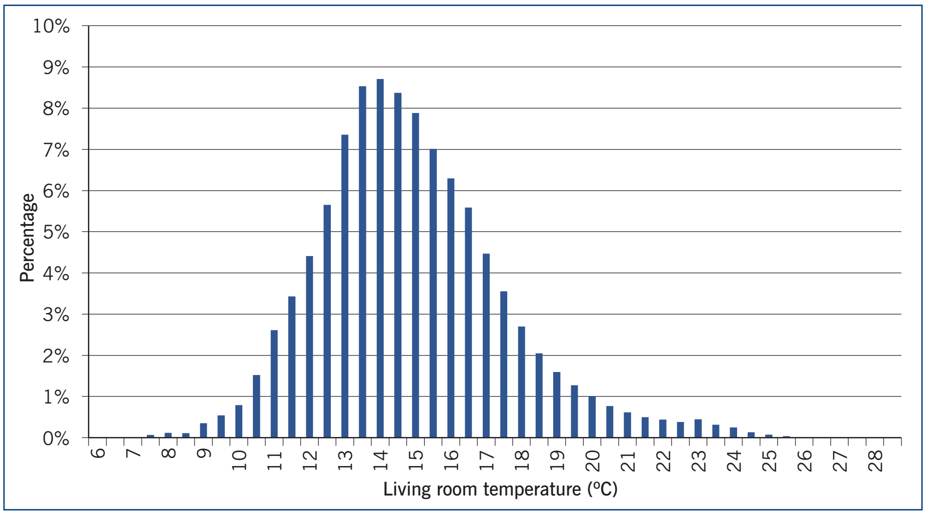
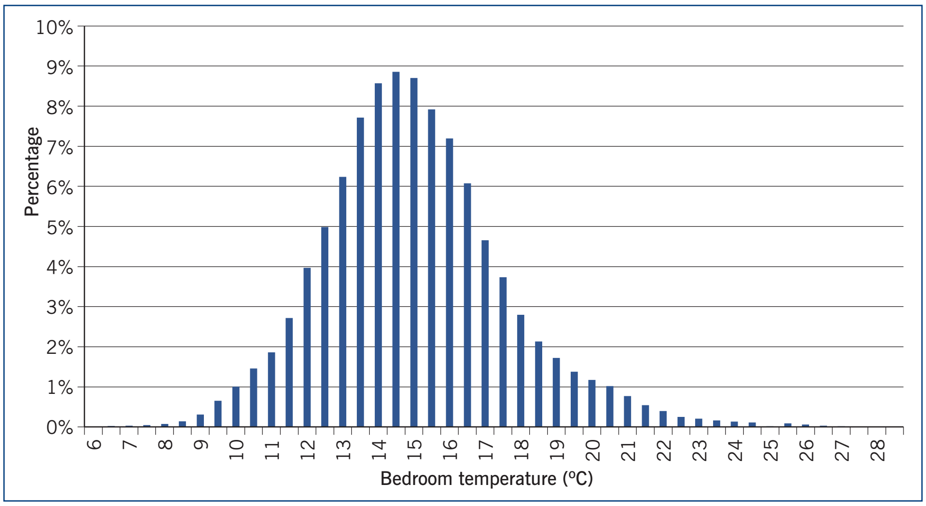


Figure 2: Distribution of bedroom temperatures



Hourly outdoor temperature and humidity was sourced from MetService's Wellington airport climate monitoring station, located less than 5km from the complex.

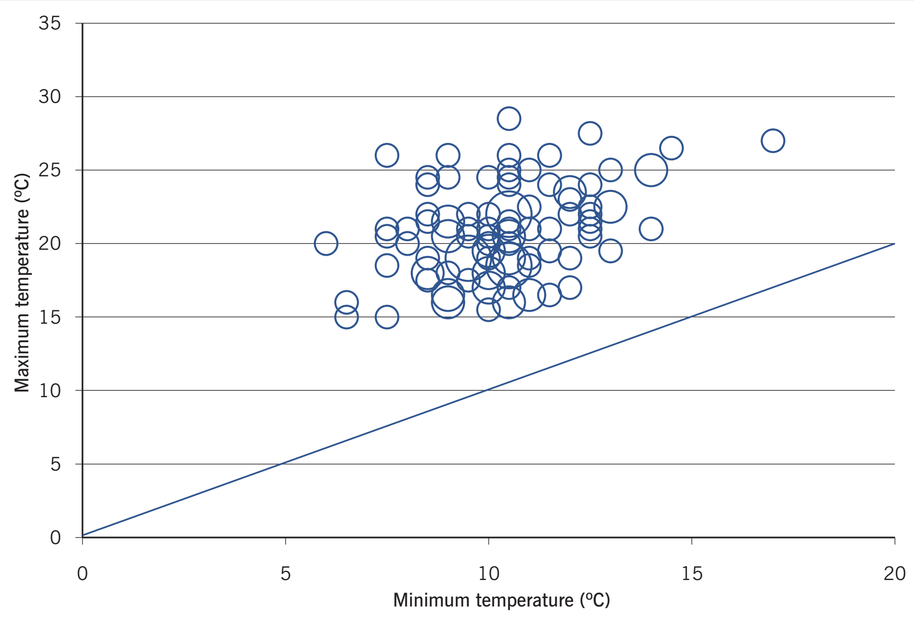
Energy usage information

Electricity information was sourced as a proxy for heating behaviour. Valid energy meter readings were obtained for 48 of the 49 dwellings with viable temperature data for a five-week period over winter. Gas is not permitted on City Housing sites (Wellington City Council, 2015a).

Data analysis

Data collected from data loggers, energy meter readings and surveys were compiled together. Data were then analysed to explore the distribution of indoor temperatures, and tenants' thermal comfort and heating behaviour. We examined the strength of the relationship between the indoor temperature and influential factors such as outdoor temperature and energy usage. Results were also compared with the most recently recorded New Zealand indoor temperatures.

Figure 3: Minimum and maximum temperatures recorded



Note: Size of bubble refers to number of data loggers that recorded the same minimum and maximum temperatures. The further the bubbles are perpendicularly from the line, the larger the range.

Table 3: Temperatures Experienced by Participants Reporting Different Levels of Thermal Comfort

	Thermal comfort rating*			
Proportion of temperature readings that were	Always cold	Often cold	Sometimes cold	Rarely cold
Less than 10ºC	3%	1%	0%	0%
Less than 12ºC	13%	10%	0%	6%
Less than 14ºC	40%	34%	0%	21%
Less than 16ºC	72%	64%	24%	53%
Less than 18ºC	86%	83%	77%	84%
Less than 21ºC	94%	94%	98%	98%
Mean	14.8ºC	15.2ºC	15.2ºC	15.6ºC
Range	6.5 – 27.5ºC	6.0 – 28.0ºC	14.0 – 24.5ºC	8.0 – 26.0ºC
N**	18	14	39	6
Dwellings***	17	14	16	5

Note: household temperature data was pooled together from the loggers in each dwelling
An example of how to read the table is as follows - those who considered their dwelling to be 'often cold' had 83% of their temperature readings below 18ºC
* 0 respondents claimed their home was 'never' cold
**77 out of 78 participants answered the question about how often their home was cold
***dwellings sum to more than 49, as some participants lived together

Results

Indoor temperatures ranged from 6.0°C to 28.5°C, with a mean temperature of 14.9°C. Most of the time (87%), indoor temperatures were lower than WHO recommendations (see Table 2 and Figures 1 and 2). Two thirds of the time indoor temperatures were less than 16°C, where resistance to respiratory disease is diminished, and 9% of the time dwellings were at temperatures of less than 12°C, with increased risk of cardiovascular disease. This issue is widespread, as almost all dwellings experienced temperatures of less than 16°C and close to three quarters of the dwellings experienced temperatures below 12°C.

Temperature ranges for each individual data logger varied substantially (Figure 3). The smallest temperature fluctuation was 5.0°C, measured in the bedrooms of two dwellings. The largest temperature fluctuation was 18.5°C, measured in another bedroom. For seven of the 49 dwellings the maximum temperature did not reach the WHO recommended minimum of 18°C. No minimum temperatures reached 18°C.

Analysis of survey data found that 42% claimed their homes were 'often' or 'always' cold throughout the year, 51% 'sometimes' and 8% 'rarely' or 'never' cold. In comparison, a city-wide survey found only 15% of Wellingtonians thought their homes were 'often' or 'always' cold, 44% 'sometimes' and 41% 'rarely' or 'never' cold (Wellington City Council, 2015b).

Participants' reports of thermal comfort at Arlington were compared with temperature readings (see Table 3). There was a slight decrease in the proportion of time dwellings were at lower temperatures across those rating their homes as 'always', 'often' and 'rarely' cold. The proportion of time dwellings were at lower temperatures in households rated as 'sometimes' cold by the occupants disrupted this trend. This is likely to be because respondents who did not know what to select chose the middle response option.

Ten per cent of all respondents did not use heating when it was cold, 44% used heating 'sometimes', 22% 'often' and 24% 'always' when cold. The most commonly given reason for the home being colder than participants would like was to keep the cost of heating down. Twenty-eight per cent of respondents also claimed their homes were 'often' or 'always' hard to heat, but the majority (54%) claimed their home was 'rarely' or 'never' hard to heat. In comparison, only 14% of Wellingtonians claimed their homes were 'often' or 'always' hard to heat, with 57% reporting that their home was 'rarely' or 'never' hard to heat (Wellington City Council, 2015b).

Temperatures fluctuated during the day. On average, dwellings were coldest in the morning and warmest in the evening (see Figure 4 and Table 4). The average living room and bedroom temperatures had a moderate but significant correlation with outdoor temperature (r=0.599 and 0.621 respectively, p<00.5).

Average energy meter readings ranged from 31.20 to 345.80kWh per week. On average energy usage was 127.20kWh per week. Pearson correlation showed that mean indoor temperatures for dwellings had a significant moderate positive correlation with electricity usage information (r=0.576, $p<0.05$). The strength of correlation with indoor temperature was similar for both heating and outdoor temperature.

Humidity readings ranged from 34%RH to 93%RH, with an average humidity reading of 68%RH. Approximately three quarters of humidity readings were over 60%RH, with a quarter of humidity readings over 75%RH. This is not ideal, as high humidity levels encourage growth of mould and bacteria and should be avoided (Environmental Protection Authority, n.d.). Thirty-one per cent of participants reported that their homes were 'often' or 'always' damp, 33% 'sometimes', and 36% 'rarely' or 'never' damp. In comparison, 10% of Wellingtonians reported that their homes were 'often' or 'always' damp, 21% 'sometimes' and 70% 'rarely' or 'never' damp (Wellington City Council, 2015b).

Figure 4: Average temperatures during winter

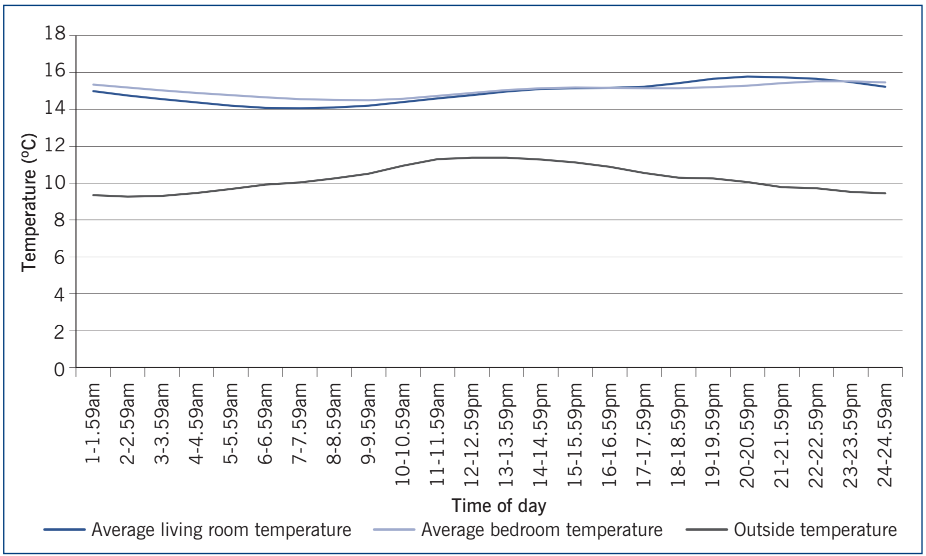


Table 4: Mean Temperatures at Arlington Over Winter

	Mean temperatures (ºC)				
Room	Overall	Morning (7 – 9am)	Day (9am – 5pm)	Evening (5 – 11pm)	Night (11pm – 7am)
Arlington living room	14.9	14.1	14.8	15.6	14.7
Arlington bedroom	15.0	14.5	14.9	15.3	15.1
Outdoor	10.2	10.1	11.1	10.1	9.5

Table 5: Mean Temperatures in NZ over winter from the HEEP study

	Mean temperatures (ºC)			
Room	Morning (7 – 9am)	Day (9am – 5pm)	Evening (5 – 11pm)	Night (11pm – 7am)
Living room	13.5 [0.6]	15.8 [-1.0]	17.8 [-2.5]	14.8 [-0.3]
Bedroom	12.6 [1.9]	14.2 [0.7]	15.0 [0.3]	13.6 [1.5]
Outdoor	7.8 [2.3]	12.0 [-0.9]	9.4 [0.7]	7.6 [1.9]

Source: adapted from Isaacs et al., 2010
Note: Difference in temperature from the current study is reported in square brackets. Negative figures indicate the national figures are greater than those at Arlington.

Discussion

Independent readings found council housing, before the upgrade, both colder and more humid than recommended, which is concerning for tenants' health. Compared to city-wide findings, Arlington was also rated as colder, damper and harder to heat than Wellington housing in general. Although thermal comfort had a complex relationship with temperature data, this study found that, overall, comfort tended to decrease with lower temperatures.

Like Arlington, the average New Zealand home does not meet WHO temperature recommendations the majority of the time. Arlington's mean indoor evening temperature in the living room (15.6°C) was considerably less than the mean national temperature in the HEEP study (17.8°C). This is despite mean evening outdoor temperature being relatively similar between the studies (see Table 5). In the morning, Arlington's mean temperature was 0.6°C warmer in the living room and 1.9°C warmer in the bedroom than the mean national temperature, but outdoor temperature was 2.3°C warmer in our study.

Heating behaviour may explain the difference in evening living room temperature noted. The HEEP study found that New Zealanders typically heat one room, usually the living room, in the evening (Isaacs et al., 2010). This accounts for the difference of 2.8°C between living room and bedroom temperatures in the HEEP study in the evening. In our study there is little variation between evening living and bedroom temperatures (0.3°C). This difference could be due to a lack of heating, with 10% of participants stating they never used heating when cold, compared to around 2% of New Zealand households who do not heat their homes at all (Howden-Chapman, Viggers et al., 2009). This may be due to the low income of social housing tenants (Statistics New Zealand, 2017), or to the size of dwellings, with heat transfer potentially easier between rooms in Arlington, which are typically apartments, compared to predominantly stand-alone houses in the HEEP study.

Comparing energy usage, participants in our study appear to use less energy than those in the HEEP study. The bottom 20% of energy users in the HEEP study consumed approximately 175kWh per week over winter,[1] nearly 40% more energy than the average weekly use in this study (127.20kWh per week) (Isaacs et al., 2006). Using less energy could be to do with affordability. After deregulation, power prices increased 85% nominally or 41% in

Table 6: Mean Indoor Temperatures in Southern North Island

Study	Mean indoor living room temperature	Outdoor temperature differential*
1971/72 Household Electricity Survey (August – September)	16.6ºC	5.6ºC
1999, 2002 – 2004 HEEP Study (August – September)	16.1ºC	6.9ºC
2015 Arlington Study (June – August)	14.9ºC	4.7ºC

Note: Data on other studies from Isaacs et al. (2010)
* Living room temperature less outdoor temperature

real terms when adjusted by the consumers price index between 2003 and 2016 (Ministry of Business, Innovation and Employment, 2017), the approximate time between the studies. However, again it could be that the size of the dwelling means less energy is required to heat Arlington dwellings to similar temperatures.

New Zealand has a diversity of climates, with the far north warmer than the far south. Therefore, it is important to try and compare temperatures in similar locations where possible. The 1971/72 Household Electricity Survey and the HEEP study (1999, 2002–04) reported mean living room temperatures, and temperature differentials with the outdoors, for the southern part of the North Island, where Wellington and the Arlington dwellings are located (see Table 6). Arlington dwellings were colder, and had a lower temperature differential between indoors and outdoors. This implies that the council housing was colder than the average New Zealand household, although readings were taken at slightly different times of the year.

In New Zealand, houses built after 1 April 1978 required a minimum level of insulation. For the section of the Arlington complex built after 1978, the mean temperature was 15.2°C, compared to 14.6°C in the pre-1978 section. This difference aligns with findings from other studies about the effects of insulation and house age. On average, indoor temperature increased by 1°C after retrofitting a small amount of insulation to the subfloor and ceiling of uninsulated New Zealand homes (Howden-Chapman, Matheson et al., 2007; Howden-Chapman, Pierse et al., 2008). The HEEP study found that post-1978 homes had on average 1°C warmer living room temperatures in the evening compared to pre-1978 homes (Isaacs et al., 2010). With respect to house age, the HEEP study also found that on average temperature fell 0.20±0.05°C per decade (French et al., 2006).

Given that Arlington is obviously considerably colder than desired, it is positive that Wellington City Council is trying to remedy the situation for its vulnerable tenants. It is recommended that all new council housing has a targeted minimum temperature of 18°C to meet WHO recommendations.

When the Labour Party's Healthy Homes Guarantee Bill (No 2) was put forward, the then building and housing minister, Nick Smith, claimed that a minimum temperature requirement for rental homes was 'impractical and stupid', as landlords cannot control tenants' heating behaviour (Hansard, 2016a, p.1). John Key, then prime minister, added that the bill only attempted to regulate indoor temperatures, as regulation could only be enforced after 'walking around other people's living rooms and bedrooms with a thermometer', which is impractical (Hansard, 2016b, p.1). Our research shows that temperature measurements can be taken in an unobtrusive manner. Work by He Kainga Oranga, the Housing and Health Research Programme has also identified structural means to address the issue of cold housing.

Late in 2016 the Residential Tenancies Amendment Bill came into effect, requiring rental properties to be insulated to at least 1978 standards. The debate continues, though, as the initial proposer of the bill, Andrew Little, claimed erroneously that there was no point in insulating homes if they are not heated properly (Sachdeva, 2016). It is noted that insulation by itself is insufficient to meet WHO indoor temperature recommendations, but it is a necessary precondition for effective heating.

In other temperate climates, such as the United Kingdom, average indoor temperatures have been increasing and are above WHO recommended levels. In national household surveys there, average winter living room temperatures were recorded as 18.3°C in 1978 and 19.1°C in 1996, an increase of 0.4°C per decade (Mavrogianni et al., 2013). Average bedroom temperatures increased to a greater extent by 1.8°C per decade, from 15.2°C in 1978 to 18.5°C in 1996. Policies should be enacted to ensure that New Zealand indoor temperatures are also improving.

Limitations

This study focused on low-income council housing tenants. However, out of necessity we compared our findings with nationally representative studies.

Average temperature changes demonstrate the overall trend, but hide a wide variation between individual dwellings, as demonstrated by the range of temperatures recorded. Minimum temperatures ranged from 6.0–14.5°C, with maximum temperatures ranging from 15.0–28.5°C.

Participants had varying definitions of what they perceived as cold. Homes where temperatures ranged from 6.0–15.0°C in one dwelling and 17.0–27.0°C in another were both rated by occupants as 'always' cold. Occupants in the same household also rated the warmth of their home differently.

An individual's exposure to different temperatures and therefore the health impact based on indoor temperature is unknown, as it is uncertain how much, when, and in what rooms individuals spend time at home. The notion that on average vulnerable New Zealanders spend 90% of their time at home indoors, when 87% of readings do not meet WHO recommendations, implies that residents are exposed to less than ideal temperatures for a substantial portion of time.

Policy implications

The council dwellings studied are thought to be colder than the average New Zealand houses. This aligns with expectations that owner-occupied houses are in better condition than rental housing. However, on average social housing is in better condition than private rentals (Buckett, Jones and Marston, 2011; Howden-Chapman, Baker and Bierre, 2013). With home ownership rates falling in New Zealand, more active government policies are needed to address housing conditions of rental properties. To be most effective a range of interventions to improve indoor temperature are required.

As a first step, information should be provided to those in high-risk dwellings about how to reduce damp and cold. Housing New Zealand's graphic, 'Keeping your home warm and dry', is a good resource (Housing New Zealand Corporation, 2017). Such information can be particularly useful to people unfamiliar with New Zealand's climate and housing.

A free home energy assessment is available for Wellington and Upper Hutt city ratepayers. This educates people on the energy performance of their home and how they can adjust their behaviour to be more energy efficient, and provides a small subsidy for products such as draught stoppers and window insulation kits. Such an initiative could be rolled out across the country.

The government should provide adequate subsidies for insulating housing. Instead of wrapping up the Warm Up New Zealand: Healthy Homes insulation grants programme in June 2018 as planned by the previous government, this should be extended and the eligibility criteria expanded so that all housing is properly insulated. Insulation has been shown to have a positive benefit–cost ratio of five to one, with health benefits for occupants (Grimes et al., 2012).

The government should also support a national roll-out of the rental warrant of fitness scheme to ensure that all rental properties meet acceptable health and living standards. The scheme is currently voluntary in Wellington, supported by the Wellington City Council. With respect to temperature-related interventions in dwellings, it looks at insulation as well as double glazing, effective curtains or blinds and weathertightness. Components need to meet adequate standards to pass (Telfar-Barnard et al., 2017).

Labour should implement its Healthy Homes Guarantee Bill (No 2), make changes to the building code, and adopt the winter energy payment it proposed (New Zealand Labour Party, n.d.), underpinned by research (Viggers et al., 2013), so that tenants are able to maintain their dwelling at 18°C at reasonable cost. Wellington City Council and Housing New Zealand already build housing to a higher standard than the current building code, indicating it is insufficient.

The winter energy payment is intended for superannuitants and beneficiaries to spend on improving the warmth of their housing through heating and investing in draught-stopping and insulation. This is similar to the UK's winter fuel payments introduced in 1997, which provide household grants to improve energy efficiency, non-means-tested winter fuel payments for those over 60, and warm home discounts and cold weather payments for those on low incomes. The payments for older people have been criticised as unfocused and poorly targeted at those suffering from fuel poverty (Thurley and Kennedy, 2017). However, research has attributed a reduction in deaths of 12,000 annually to the payments (Age UK, 2015; Iparraguirre, 2014).

With respect to other related UK initiatives, the Home Energy Conservation Act 1995 requires local councils to have an action plan to improve the energy efficiency of housing in their area and report back to the government on progress (Test Valley Borough Council, 2017; UK Government, 2017). A first report was to be completed by councils by 31 March 2017 and biennially after this. It will be interesting to see the impact on housing temperature and whether it should be adopted in New Zealand.

The temperature of New Zealand housing should be monitored on a systematic and ongoing basis, in order to determine whether the issue of cold housing is improving and in response to what initiatives. Temperature measures are currently being planned in conjunction with the next New Zealand General Social Survey in 2018.

Conclusion

New Zealand still has a way to go to meet minimum temperature recommendations. With New Zealand's high rate of excess winter mortality and 42,000 children hospitalised every year for diseases associated with unhealthy homes, this is something that should be addressed sooner rather than later.

1 This has been derived from Isaacs et al.'s (2006) finding that the bottom 20% of households use 4,860 kWh/yr of electricity. On average this equates to 93.46kWh per week. However, Isaacs et al. also state that household energy consumption varies seasonally and often rises by a factor of nearly three from summer to winter.

Acknowledgements

We would like to acknowledge the Wellington City Council, City Housing tenants and Zhang Wei with their help in carrying out this study, as well as funding from the Health Research Council of New Zealand, grant 15-429.

References

Age UK (2015) 'Winter fuel payment prevents 12,000 deaths yearly', retrieved from https://www.ageuk.org.uk/latest-press/archive/winter-fuel-payment-prevents-12000-deaths-yearly/

Baker, M., M. Keall, A. Ee Lyn and P. Howden-Chapman (2007) 'Home is where the heart is – most of the time', *New Zealand Medical Journal,* 120 (1264), pp.113–6

Buckett, N., M. Jones and N. Marston (2011) *BRANZ 2010 House Condition Survey: condition comparison by tenure,* study report 264, Wellington: BRANZ, retrieved from https://www.branz.co.nz/cms_show_download.php?id=53af2b0c2e5ca5169a0176996bba7ee88de082c0

Burgess, J.C.E., N.R. Buckett, M.J.T. Camilleri, L.J. French, A.R. Pollard and P.J. Hancock (2008) *Final Monitoring Report from the Papakowhai Renovation Project,* Auckland: beacon Pathway, retrieved from http://www.beaconpathway.co.nz/images/uploads/Final_Report_TE106(15)_Papakowhai_final_performance_monitoring_Jan09.pdf

Davie, G., M. Baker, S. Hales and J. Carlin (2007) 'Trends and determinants of excess winter mortality in New Zealand: 1980 to 2000', *BMC Public Health,* 7 (263), doi:10.1186/1471-2458-7-263

Donaldson, G., S. Ermakov, Y. Komarov, C. McDonald and W. Keatinge (1998) 'Cold related mortalities and protection against cold in Yakutsk, eastern Siberia: observation and interview study', *British Medical Journal,* 317, pp.978–82

Environmental Protection Authority (n.d.) 'Mold course chapter 2', retrieved from https://www.epa.gov/mold/mold-course-chapter-2

French, L., M. Camilleri, N. Isaacs and A. Pollard (2006) *'Winter temperatures in New Zealand houses, conference paper 123,* presented at the Comfort and Energy Use in Buildings – Getting Them Right, conference, Windsor, UK, retrieved from http://www.branz.co.nz/cms_show_download.php?id=8478d968515ad24b90d44165b95ee3f04e796a10

Giancola, E., S. Soutullo, R. Olmedo and M. Heras (2014) 'Evaluating rehabilitation of the social housing envelope: experimental assessment of thermal indoor improvements during actual operating conditions in dry hot climate, a case study', *Energy and Buildings,* 75, pp.264–71

Grimes, A., T. Denne, P. Howden-Chapman, R. Arnold, L. Telfar-Barnard, N. Preval and C. Young (2012) *Cost Benefit Analysis of the Warm Up New Zealand: Heat Smart Programme,* Wellington: MOTU for Ministry of Economic Development, retrieved from www.motu.org.nz/publications/detail/cost_benefit_analysis_of_the_warm_up_new_zealand_heat_smart_programme

Hales, S., T. Blakely, R. Foster, M. Baker and P. Howden-Chapman (2012) 'Seasonal patterns of mortality in relation to social factors', *Journal of Epidemiology and Community Health,* 66 (4), pp.379–84, doi:10.1136/jech.2010.111864

Hansard (2016a) 'Healthy Homes Guarantee Bill (No 2) – first reading', *New Zealand Parliamentary Debates,* vol.703, p.10812, 4 May, retrieved from https://www.parliament.nz/en/pb/hansard-debates/rhr/document/51HansD_20160504_00000036/healthy-homes-guarantee-bill-no-2-first-reading

Hansard (2016b) 'Volume 713, Week 45 – Tuesday 3 May 2016', *New Zealand Parliamentary Debates,* vol.713, 3 May, retrieved from https://www.parliament.nz/en/pb/hansard-debates/rhr/document/51HansD_20160503/volume-713-week-45-tuesday-3-may-2016

Housing New Zealand Corporation (2017) 'Keeping your home warm and dry', retrieved from https://www.close2home.co.nz/assets/Documents/Keeping-your-home-warm-and-dry.pdf

Howden-Chapman, P., M. Baker and S. Bierre (2013) 'The houses children live in: policies to improve housing quality', *Policy Quarterly,* 9 (2), pp.35–9

Howden-Chapman, P., A. Matheson, J. Crane, H. Viggers, M. Cunningham, T. Blakely et al. (2007) 'Effect of insulating existing houses on health inequality: cluster randomised study in the community', *British Medical Journal,* 334, pp.460–4

Howden-Chapman, P., N. Pierse, S. Nicholls, J. Gillespie-Bennett, H. Viggers, M. Cunningham et al., (2008) 'Effects of improved home heating on asthma in community dwelling children: randomised community study', *British Medical Journal,* 337, pp.852–5

Howden-Chapman, P., H. Viggers, R. Chapman, D. O'Dea, S. Free and K. O'Sullivan (2009) 'Warm homes: drivers of the demand for heating in the residential sector in New Zealand', *Energy Policy,* 37 (9), pp.3387–99, doi:https://doi.org/10.1016/j.enpol.2008.12.023

Howden-Chapman, P., H. Viggers, R. Chapman, K. O'Sullivan, L. Telfar-Barnard and B. Lloyd (2012) 'Tackling cold housing and fuel poverty in New Zealand: a review of policies, research, and health impacts', *Energy Policy, 49,* pp.134–42, doi:https://doi.org/10.1016/j.enpol.2011.09.044

Iparraguirre, J. (2014) 'Have winter fuel payments reduced excess winter mortality in England and Wales?', *Journal of Public Health,* 37 (1), pp.26–33

Isaacs, N., M. Camilleri, L. French, A. Pollard, K. Saville-Smith R. Fraser et al. (2006) *Energy Use in New Zealand Households: report on the year 10 analysis for the Household Energy End-use Project (HEEP),* study report 155, Wellington: BRANZ, retrieved from http://www.branz.co.nz/cms_show_download.php?id=b1ab61dd06f50e83e6a184b29b68a989472502ed

Isaacs, N., K. Saville-Smith, M. Camilleri and L. Burrough (2010) 'Energy in New Zealand houses: comfort, physics and consumption', *Building Research and Information,* 38 (5), pp.470–80, doi:http://dx.doi.org/10.1080/09613218.2010.494383

Lloyd, B. and M. Callau (2006) *Monitoring of Energy Efficiency Upgrades in State Houses in Southern New Zealand,* Dunedin: Energy Management Group, Physics Department, University of Otago, retrieved from http://www.physics.otago.ac.nz/eman/hew/Downloads/HNZC_Report_1.pdf

Mavrogianni, A., F. Johnson, M. Ucci, A. Marmot, J. Wardle, T. Oreszczyn and A. Summerfield (2013) 'Historic variations in winter indoor domestic temperatures and potential implications for body weight gain', *Indoor + Built Environment,* 22 (2), pp.360–75, doi:10.1177/1420326X11425966

Maxim Integrated (2014) Data loggers, retrieved from https://para.maximintegrated.com/search.mvp?fam=data-loggersand808=iButtonand1028=Temperature

Ministry of Business, Innovation and Employment (2017) 'Sales-based electricity costs', retrieved from http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/statistics/prices/electricity-prices/sales-based-residential-prices.pdf

New Zealand Labour Party (n.d.) 'Winter energy payment', retrieved from http://www.labour.org.nz/winter_energy_payment

OneTemp (2015) HOBO U10 Temperature Relative Humidity Data Logger – U10-003, retrieved from http://www.hobodataloggers.com.au/hobo-u10-temperature-relative-humidity-data-logger-u10-003

Ormandy, D. and V. Ezratty (2012) 'Health and thermal comfort: from WHO guidance to housing strategies', *Energy Policy,* 49, pp.116–21

Pierse, N., R. Arnold, M. Keall, P. Howden-Chapman, J. Crane and M. Cunningham (2013) 'Modelling the effects of low indoor temperatures on the lung function of children with asthma', *Journal of Epidemiology and Community Health,* 67 (11), pp.918–25, doi:http://dx.doi.org/10.1136/jech-2013-202632

Povey, D. and U. Harris (2005) *Old, Cold, and Costly? A survey of low income private rental housing in Dunedin 2004,* Dunedin: Presbyterian Support Otago, retrieved from https://psotago.org.nz/assets/Documents/Old-Cold-and-Costly-0.pdf

Rangiwhetu, L., N. Pierse and P. Howden-Chapman (2017) 'Effects of minor household interventions to block draughts on social housing temperatures: a before and after study', *Kōtuitui: New Zealand Journal of Social Sciences Online,* doi:http://dx.doi.org/10.1080/1177083X.2017.1372787

Rosemeier, K. (2014) 'Healthy and affordable housing in New Zealand: the role of ventilation', PhD thesis, University of Auckland, retrieved from https://researchspace.auckland.ac.nz/handle/2292/21764

Sachdeva, S. (2016) 'Labour makes another push for rental heating and insulation standards', *Stuff,* 3 May, http://www.stuff.co.nz/national/politics/79563822/Labour-makes-another-push-for-rental-heating-and-insulation-standards

Statistics New Zealand (2017) *Investigating different measures of energy hardship in New Zealand,* Wellington: Statistics New Zealand, http://archive.stats.govt.nz/browse_for_stats/people_and_communities/Households/energy-hardship-report.aspx

Stitt, A. (2013) 'The role of council housing: an operational view of Wellington City housing', in S. Bierre, P. Howden-Chapman and L. Early (eds), *Homes People Can Afford: how to improve housing in New Zealand,* Wellington: Steele Roberts

Taptiklis, P. and R. Phipps (2017) *Indoor Air Quality in New Zealand Homes and Schools: a literature review of healthy homes and schools with emphasis on the issues pertinent to New Zealand,* Wellington: BRANZ, retrieved from http://www.branz.co.nz/cms_show_download.php?id=c847ab66383cfa20a355b2679cf75f3d1faee6c4

Telfar-Barnard, L., M. Baker and S. Hales (2008) 'The role of housing type and socio-economic status in New Zealand excess winter hospitalisation patterns', paper presented at the fifth Warwick Healthy Housing Conference, University of Warwick

Telfar-Barnard, L., J. Bennett, P. Howden-Chapman, D.E. Jacobs, D. Ormandy, M. Cutler-Welsh et al. (2017) 'Measuring the effect of housing quality interventions: the case of the New Zealand "rental warrant of fitness"', *International Journal of Environmental Research and Public Health,* 4

Test Valley Borough Council (2017) 'Home Energy Conservation Act (1995) (HECA) report', retrieved from https://www.testvalley.gov.uk/housingandenvironmentalhealth/housing/private-sector-housing/energyefficiency/home-energy-conservation-act-1995-heca-report?displaypref=large

Thurley, D. and S. Kennedy (2017) *Winter Fuel Payments Update,* briefing paper, retrieved from https://www.google.co.nz url?sa=tandrct=jandq=andesrc=sandsource=webandcd=1andved= 0ahUKEwjvpcjDyrDXAhWGjpQKHQ1cAnAQFggnMAAandurl=http%3A%2F%2Fresearchbriefings.files.parliament.uk%2Fdocuments%2FSN06019%2FSN06019.pdfandusg=AOvVaw2Cm-5j-YtzLFCV3sEEqAXJ

UK Government (2017) 'Guidance to English energy conservation authorities: the Home Energy Conservation Act 1995', retrieved from https://www.gov.uk/government/publications/guidance-to-english-energy-conservation-authorities-the-home-energy-conservation-act-1995

Viggers, H., P. Howden-Chapman, T. Ingham, R. Chapman, G. Pene, C. Davies et al. (2013) 'Warm homes for older people: aims and methods of a randomised community-based trial for people with COPD', *BMC Public Health,* 13 (176), doi:10.1186/1471-2458-13-176

Wellington City Council (2015a) *City Housing Design Guide*

Wellington City Council (2015b) *Wellington City Council 2014/15 Annual Report,* retrieved from https://wellington.govt.nz/~/media/your-council/plans-policies-and-bylaws/plans-and-policies/annualreport/2014-15/2014-15-annual-report.pdf

Wellington City Council (2016) *City Housing Design Guide*

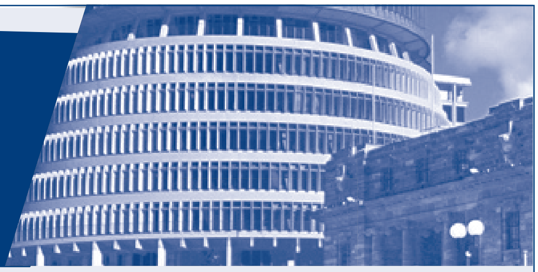
White, V., M. Jones, V. Cowan and S. Chun (2017) *BRANZ 2015 House Condition Survey: comparison of house condition by tenure',* study report 370, Wellington: BRANZ, retrieved from http://www.branz.co.nz/cms_show_download.php?id=a1efff0a2fd9885ecf878ce475631df7025cf3b8

THIRD INTERNATIONAL CONFERENCE ON

WELLBEING & PUBLIC POLICY

Wednesday 5th – Friday 7th September, 2018

New Zealand Parliament Buildings & Victoria University of Wellington



This third in the series of international conferences on Wellbeing and Public Policy will (1) critically evaluate the rapidly expanding field of wellbeing research across a range of disciplines; (2) share the work of leading international organisations; and (3) distil ideas and practices which will aid governments in developing a wellbeing approach to public policy.

Our four plenary speakers are Edward Diener (the University of Utah and the University of Virginia, USA), Martijn Burger (Director, Erasmus Happiness Economics Research Organization, the Netherlands), Jan-Emmanuel De Neve (University of Oxford, United Kingdom) and Carla Anne Houkamau (the University of Auckland). Ministers and senior officials from the New Zealand Government will participate in the conference as will members of leading international organisations, including the OECD.

Conference themes:

- Wellbeing and inequality
- Culture, indigeneity and wellbeing (incorporating Māori wellbeing)
- Wellbeing, hope and perceptions of the future
- Sustainability, capital stocks and wellbeing
- Children and young people's wellbeing
- Wellbeing, utilitarianism and the capabilities approach
- Technology and wellbeing
- Wellbeing – cause or effect?
- Wellbeing – policy and practice

Early bird registration is available through to 25 June 2018.
See more on the website:
http://www.confer.nz/wellbeingandpublicpolicy2018

HOSTED BY

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI VICTORIA UNIVERSITY OF WELLINGTON

THE TREASURY Kaitohutohu Kaupapa Rawa

IJW