Kids in the cold: outcomes for New Zealand households with children using prepayment metering for electricity

Kimberley C O’Sullivan, Philippa L Howden-Chapman, James Stanley, Simon Hales

Abstract

Aims Although fuel poverty is becoming increasingly researched, there is very limited information currently available on the experiences of and effects on children living in fuel poverty. This paper examines the consequences of using prepayment metering, a payment method typically used by low-income households, on households with children.

Methods We present new results from two postal survey datasets, the Electricity Prepayment Meter Users’ Survey undertaken in late 2010 and the follow-up survey undertaken in 2011, which explore the outcomes of prepayment metering and living on low-incomes for households with children.

Results Among prepayment consumers, households with children experience greater levels of hardship. Households with children were statistically significantly more likely to cut back on grocery spending, and indicated greater levels of financial difficulty than childless households. Although there were no differences between the groups for most indicators of poor thermal comfort levels, households with children were statistically significantly more likely to report seeing their breath condensing indoors on at least one occasion during the winter.

Conclusions Policies to address fuel poverty should include protections for prepayment meter consumers, and households with children using this payment method who are especially vulnerable.

Fuel poverty has commonly been defined as the inability to afford adequate household energy services, including maintaining World Health Organization (WHO) recommended indoor temperatures, for less than 10% of household income.\textsuperscript{1,2} Fuel poverty presents a multisectorial challenge because it is caused by the energy inefficiency of the house and the available heating sources, combined with income poverty, which prevent the household from achieving healthy temperatures.\textsuperscript{1,3} Drivers of fuel poverty in New Zealand, where the problem is estimated to affect one in four households, include the poor quality of the housing stock, relatively high levels of income inequality, and the increasing price of electricity which occurred after deregulation of the industry.\textsuperscript{4,5} Fuel poverty has received little attention in New Zealand which has no official definition or measurement of fuel poverty, or specific policy to address the issue.\textsuperscript{5,6} This is in contrast with other jurisdictions, such as the United Kingdom where the Parliament, with all-party support, agreed to aim to eradicate fuel poverty as far as reasonably practical by 2016.\textsuperscript{7}
The effects of fuel poverty are broad, with typical coping strategies of fuel poor households identified by several studies falling into three broad categories including: self-rationing of energy consumption, e.g. restricting heating, lighting, and use of hot water; financial redistribution through restricting other spending, e.g. limiting grocery spending; and in some cases debt and disconnection from energy or other services.8-10

A recent review of the health impacts of cold homes and fuel poverty in the United Kingdom highlights many findings which are applicable to New Zealand.11 In particular, the Marmot Review Team (p 11), commented:

“Fuel poor households must choose either to spend more than 10% of their income on heating, which has a detrimental impact on other aspects of health and well-being, or to under-consume energy and live in a cold home to save money. Deprived and vulnerable households – especially those who do not have access to social housing – are more likely to live in energy inefficient housing, and less likely to have the resources or the resilience to deal with the negative impacts of cold homes and reduced income.”11

The WHO recommends maintaining indoor temperatures of between 18°C and 24°C for the general population.12 For vulnerable groups, such as the very old or young, a minimum temperature of 20°C is recommended. These temperature ranges have been debated, perhaps due to the use of the term “thermal comfort”, in the guideline. Whether electricity conservation, including reducing indoor temperatures below comfortable levels, contributes negatively to mental health may be dependent on attitudes and cultural factors.10,13

Problematically, in New Zealand space heating is undervalued, and indoor temperatures are cold by international standards.4 However as Ormandy and Ezratty (In press, p1) note:

“While the term ‘thermal comfort’ is used to cover a variety of circumstances, the World Health Organization’s guidance on thermal comfort is not just about ensuring a sensation of satisfaction with the ambient temperature, it is inextricably linked to health. It is a guidance for the home environment, and aimed at protecting health, particularly the health of those most susceptible and fragile to temperatures outside that range, such as the very young, and older people.”14

In elderly people, respiratory effects have been shown to occur below 16°C, (in those with chronic respiratory disease below 21°C), while increases in blood pressure are seen below 12°C, and risk of hypothermia increases below 6°C.11,14,15

Fuel poverty and cold indoor temperatures contribute to excess winter mortality and morbidity, especially in temperate countries. A recent study linking New Zealand census and mortality data found the highest risk of dying in winter among low-income people, those living in rented accommodation and those living in cities.16

While most of the earlier studies investigating the physiologic effects of adverse temperatures on health focused on adults, some research highlights the outcomes for children. In children with asthma, increasing temperatures inside the home has been shown to reduce symptoms and days off work and school.17,18 Reduced calorific intake in the winter in low-income families is evidence of the ‘heat or eat’ problem in the United States.19

One Boston study found that children from households receiving the Low-Income Home Energy Assistance Programme payments to assist with home energy costs were less likely to suffer undernutrition, be overweight, or require acute hospitalisation.20
Child health and development in children less than three years of age is negatively affected by household energy insecurity, defined as the household having had an unheated or uncooled day, using a cooking stove for heating, or being threatened with or having been disconnected from utility services in the previous year.\textsuperscript{21}

A narrative synthesis of five intervention studies examining specific effects of cold housing on health noted that the effects of fuel poverty on children is under-researched, but that adolescents living in cold housing are at risk of mental health problems and engage in increased antisocial behaviour.\textsuperscript{22}

At the extreme end of the spectrum, children appear to be over-represented in fatalities from unintentional domestic fires relating to fuel poverty. In a report investigating fatal unintentional domestic fires in New Zealand from 1997–2003, 131 deaths were identified in total, 10\% of these were due to unattended candle fires, the third most significant risk factor for residential fire fatality.\textsuperscript{23}

There were 13 deaths in eight candle fires during the study period; eight of these victims were children.\textsuperscript{23} In three households the electricity had been disconnected for non-payment, another household had no electricity due to remote location.\textsuperscript{23}

Stories of local families struggling to manage high electricity costs, cold homes, and low-incomes are not new, with several examples making headlines in recent years.\textsuperscript{24–26} One group of consumers likely to experience high rates of fuel poverty are those using prepayment metering, an electricity payment method often used by low-income consumers with electricity debt, or who have difficulty budgeting.\textsuperscript{27}

While there are advantages of prepayment metering such as reduced electricity consumption, and greater awareness and control of electricity use,\textsuperscript{28,29} low income households tend to have less discretionary electricity consumption and therefore fewer opportunities for reducing consumption.\textsuperscript{30} One of the most significant disadvantages to using prepayment metering is the risk of households “self-disconnecting”\textsuperscript{*} or running out of credit on their prepayment meters, resulting in their household being without electricity services, which may have serious health consequences.

\textsuperscript{*} The term “self-disconnection” refers to the service being shut off when a prepayment meter runs out of credit. While the term problematically implies the consumer has agency to make a choice to disconnect, the term is widely used and understood so we use it here.

We investigated the use of prepayment metering from a consumer perspective in a nationwide postal survey of electricity prepayment meter users, and found that while almost all respondents felt the benefits of using prepayment outweighed the risks of running out of credit or self-disconnection, over half of respondents experienced self-disconnection in the past year.\textsuperscript{31}

One third of respondents experiencing self-disconnection were without electricity for more than 12 hours, and 17.0\% reported six or more events in the past year. A follow-up postal survey in late 2011 investigated whether patterns of self-disconnection within households had changed over time and explored the heating practices of households using prepayment metering.\textsuperscript{32}

The study found that self-disconnection remained problematic over time, and that prepayment metering encourages restriction of space heating in already cold homes.
Over half (57.0%) of respondents reported restricting space heating, although more than two-thirds reported experiencing shivering and more than half being able to see their breath condensing inside their home during the winter months on at least one occasion. 

Parents and caregivers responding to the survey commented on the negative impacts of electricity prepayment metering on their children, for example “the kids get sick of me telling them to conserve power”, indicating increased family tension.

The consequences of self-disconnection were more problematic, with some adult respondents stating that the worst thing about their last self-disconnection event was “not being able to prepare baby’s bottle”, or “can’t cook my kids dinner”. Although not a focus of the original study design, these comments indicate there are specific issues faced by families using prepayment metering which may increase hardship experienced by children in these households.

Given that New Zealand has high rates of child poverty, and poor child health and wellbeing equity in general, households with children, who use prepayment metering to pay for electricity, may be particularly vulnerable to the disadvantages of using this payment method.

In this paper, we present new results from two survey datasets, the Electricity Prepayment Meter Users’ Survey undertaken in late 2010 and the follow-up survey undertaken in 2011, which explore the outcomes of prepayment metering for households with children.

**Methods**

The Electricity Prepayment Meter Users’ Survey 2010, fully described elsewhere, was a nationwide postal survey undertaken with the support of three major electricity retailers in New Zealand who provided an anonymised random sample to investigate the advantages and disadvantages of using prepayment metering from a consumer perspective. In 2008, 52,664 prepayment meters were used in New Zealand (Electricity Commission 2008), which equates to around 3% of households. The 2010 survey sample included a total number of 768 customers, calculated presuming a response rate of 50% (384), providing adequate study power assuming 50% frequency of self-disconnection in the population. The final response rate for the 2010 survey, which included a rigorous protocol of repeat mailings was 47.9%. Of the 359 respondents to the 2010 survey, 324 (90.2%) agreed to postal follow-up and were included in the 2011 sample. The 2011 survey, also fully described elsewhere, achieved a response rate of 61.0% using a similar protocol.

In both years respondents were offered a $20 supermarket voucher to thank them for completing the survey, which were sent by the researchers on receipt of the survey form.

Survey data for both years were entered into a Microsoft Access database and analysed using Epi Info version 3.4 (Center for Disease Control, Atlanta, GA). The uncorrected chi-squared test was used for significance testing, with an alpha level of ≤0.05.

**Results**

Households with children made up 54.3% of the respondents to the 2010 survey, and 47.8% of the 2011 survey. Comparison of responses to the 2010 survey found few sociodemographic differences between those who did not consent to postal follow-up, those who consented but did not respond to the 2011 survey, and those who consented and responded to the 2011 survey.
Statistically significant differences were found between the groups for households with children (Chi squared = 9.53, p value = 0.009), who were over-represented in the group that consented, but did not take part in the 2011 survey.\footnote{32}

The average expenditure per month on electricity differed in households with children ($175.06 in 2011, and $158.78 in 2010) and households without children ($128.38 in 2011, and $119.48 in 2010). For households with children, the median expenditure per month of $160.00 in 2011 was unchanged from 2010, whereas in households without children, median expenditure rose to $120.00 per month in 2011 from $100.00 in 2010.

Results from the 2010 survey found that households with children were significantly more likely to report that they first found out about using prepayment from family or friends (Table 1). Indicators of ‘bill stress’ were marginally significantly more common for households with children (p≤0.10).

These bill stresses included: starting prepayment metering because of debt accruing on the electricity account; being unable to pay any of the telephone, gas, or water bills in the past year; and having help from family or friends to pay for electricity in the past year. The likelihood of experiencing a self-disconnection event in the past year was also marginally significantly higher among households with children, with 57.8% reporting an event compared with 47.4% of households without children.

Table 1. Self-disconnection and bill stress in households with and without children in 2010

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Children Proportion (95% CI)</th>
<th>No children Proportion (95% CI)</th>
<th>Chi-squared and p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Started using prepayment because debt had built up on the electricity account</td>
<td>26.5% (20.3–33.5)</td>
<td>18.6% (12.8–25.6)</td>
<td>χ²=2.99, p=0.084</td>
</tr>
<tr>
<td>First found out about using prepayment metering from family or friends</td>
<td>60.0% (52.6–67.1)</td>
<td>45.5% (37.5–53.7)</td>
<td>χ²=7.14, p=0.008</td>
</tr>
<tr>
<td>Self-disconnection event in past 12 months</td>
<td>57.8% (50.4–65.0)</td>
<td>47.4% (39.5–55.6)</td>
<td>χ²=3.68, p=0.055</td>
</tr>
<tr>
<td>Unable to pay any of telephone, gas, or water bills by due date in past 12 months</td>
<td>44.9% (37.6–52.3)</td>
<td>35.3% (27.8–43.3)</td>
<td>χ²=6.64, Probability=0.084</td>
</tr>
<tr>
<td>Had a grant or loan from family or friends to help pay electricity in past 12 months</td>
<td>17.3% (12.1–23.5)</td>
<td>10.9% (6.5–16.9)</td>
<td>χ²=2.82, p=0.093</td>
</tr>
</tbody>
</table>

Results significant at an alpha level of ≤0.05 are highlighted in this and all following tables.

Results from the 2011 follow-up survey similarly found trends that households with children were experiencing greater bill stress than childless households. Receiving help from family or friends over the past year to pay for electricity was marginally significantly more likely among households with children.

The follow-up survey also investigated whether households using prepayment metering restrict grocery spending to afford electricity. Almost three of five
households with children (56.8%) reported cutting back on groceries to pay for electricity, compared with 2 (41.2%) of 5 childless households (p ≤ 0.05).

When asked if they would be able to access $500 in the next week for a family emergency, the trend was for households with children to report more difficulty in both survey years (Table 2). Households with children were statistically significantly more likely to report that the money would be unattainable.

Households with children were four times as likely to report that they could use a money-lender in 2010, (16.2% compared to 3.8% of childless households, p ≤ 0.01) an indicator of a precarious financial position. In 2011 the difference was reduced but the absolute numbers increased with more households in both groups reporting they could use a money-lender. Even so, households with children remained over 2½ times more likely to report that they would use a money-lender (22.5% in households with children, 8.5% without children, p ≤ 0.05).

### Table 2. Options to access $500 in the next week in case of family emergency for households with and without children

<table>
<thead>
<tr>
<th>Options to access money in a family emergency</th>
<th>2010 Survey results</th>
<th>2011 Follow-up survey results</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Children Proportion (95% CI)</td>
<td>No Children Proportion (95% CI)</td>
<td>Significance Chi-squared p-value</td>
</tr>
<tr>
<td>Self-funded</td>
<td>28.6% (22.3–35.7)</td>
<td>35.3% (27.8–43.3)</td>
<td>χ²=1.71 p=0.191</td>
</tr>
<tr>
<td>Family or friends</td>
<td>33.5% (26.8–40.8)</td>
<td>23.7% (17.3–31.2)</td>
<td>χ²=3.94 p=0.047</td>
</tr>
<tr>
<td>Work and Income</td>
<td>16.8% (11.7–22.9)</td>
<td>15.4% (10.1–22.0)</td>
<td>χ²=0.12 p=0.731</td>
</tr>
<tr>
<td>Bank</td>
<td>10.8% (6.7–16.2)</td>
<td>16.0% (10.6–22.7)</td>
<td>χ²=2.01 p=0.156</td>
</tr>
<tr>
<td>Money-lender</td>
<td>16.2% (11.2–22.3)</td>
<td>3.8% (1.4–8.2)</td>
<td>χ²=13.71 p=0.000</td>
</tr>
<tr>
<td>Not available</td>
<td>31.4% (24.7–38.6)</td>
<td>21.8% (15.6–29.1)</td>
<td>χ²=3.92 p=0.048</td>
</tr>
</tbody>
</table>

Indoor temperature data were not collected from participants in this study, however the follow-up survey included questions to investigate self-rated thermal comfort. Similar indicators have been used in other studies as a proxy for objective measurements when assessing whether indoor temperatures are likely to fall within healthy ranges, and to indicate whether households suffer fuel poverty.14,34

There were no significant differences between the groups for four of the indicators, although at least two-thirds of the respondents to the survey reported problems achieving thermal comfort overall (Table 3). However, households with children were statistically significantly (p ≤ 0.01) more likely to report being able to see their breath condensing inside their home on at least one occasion during the winter months, with 71.3% of households with children reporting this problem, compared to just under half of childless households.
Table 3. Indicators of thermal comfort in households with and without children in 2011

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Children Proportion (95% CI)</th>
<th>No Children Proportion (95% CI)</th>
<th>Chi-squared and p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>House has been cold this winter</td>
<td>80.7% (70.9–88.3)</td>
<td>75.0% (65.1–83.3)</td>
<td>$\chi^2=0.86$, $p=0.355$</td>
</tr>
<tr>
<td>Used heating when cold this winter</td>
<td>83.0% (73.4–90.1)</td>
<td>85.6% (77.0–91.9)</td>
<td>$\chi^2=0.24$, $p=0.625$</td>
</tr>
<tr>
<td>Had house colder than would have liked this winter</td>
<td>71.9% (61.4–80.9)</td>
<td>67.4% (57.0–76.6)</td>
<td>$\chi^2=0.45$, $p=0.503$</td>
</tr>
<tr>
<td>Shivered inside this winter on at least one occasion</td>
<td>70.5% (59.8–79.7)</td>
<td>66.3% (55.9–75.7)</td>
<td>$\chi^2=0.36$, $p=0.548$</td>
</tr>
<tr>
<td>Saw breath condensing inside this winter on at least one occasion</td>
<td>71.3% (60.6–80.5)</td>
<td>48.4% (38.0–58.9)</td>
<td>$\chi^2=9.82$, $p=0.002$</td>
</tr>
</tbody>
</table>

Reasons for having the house colder than they preferred over the winter months were not significantly different between households with and without children. There were also no significant differences in the heating types used as the main heating source.

More households with children named “other” heating sources as the main heating source, most commonly these were specified as using no heating, or using additional blankets or clothes, though again the small difference (15.7% compared with 9.3% of childless households) was not significant.

When asked what the reasons for using the heater type specified as the primary heating source were, the only significant difference between the groups was that households with children were less likely to identify convenience as a reason than households without children (34.8% compared to 49.5%, $p \leq 0.05$).

Discussion

The results of this paper suggest that, among prepayment consumers, households with children experience greater levels of hardship. This is in the context of prepayment customers already experiencing financial hardship compared to the general population, with lower levels of home ownership, low household income, and high rates of bill stress, while paying 3–38% more per unit of electricity by using this payment method depending on regional pricing differences.25,31,35

Households with children were significantly more likely to report cutting back on grocery spending to afford electricity than childless households, which has other flow-on effects on health and wellbeing.19,20 The problems highlighted here are likely to affect a significant number of children. Based on the most recent national figure of prepayment metering consumers from 2008,36 around 28,000 households using prepayment metering have at least one child under the age of 18.

As the surveys were not designed to look at households with children specifically, the samples are too small to be definitive; however households with children were significantly more likely to report being able to see their breath condensing indoors on at least one occasion during the winter months than childless households. Almost three quarters (71.3%) of households with children experienced this problem, compared to just under half (48.4%) of childless households.
Although reasons for this are complicated, with several potential contributing factors including greater indoor humidity due to higher household occupancy and heating and behavioural practices, households experiencing this problem are unlikely to be achieving indoor temperatures adequate for safeguarding health. Despite there being no differences between the groups for the remaining indicators of poor thermal comfort used, more than two-thirds of study respondents overall reported problems achieving thermal comfort and, by inference, healthy indoor temperatures.

Children living in households that use prepayment metering are likely to be living in fuel poverty, as well as experiencing the effects of general poverty, both factors which are harmful to child health and wellbeing.\textsuperscript{17,18,22,33} Further research that specifically focuses on both the experiences of and outcomes for children in fuel poor households is urgently needed. This should also include exploring alternatives to prepayment metering such as the use of informative billing and in home display devices which could provide some of the benefits of increased consumer information and control of home energy use without the risk of self-disconnection.\textsuperscript{5}

While the problem of fuel poverty is tied to income poverty, energy inefficiency of housing and heating appliances are contributory problems. In New Zealand, fuel poverty is partly driven by the structure of the electricity market and ongoing price increases in the domestic electricity sector,\textsuperscript{4,5} which are likely to be exacerbated by further privatisation of the market.

An official definition of fuel poverty must be developed in order to allow measurement of the scale and depth of the problem in New Zealand. This will allow for targeting and monitoring of specific multisectorial policies required to address widespread fuel poverty. There has been some recent policy and academic discussion of this.\textsuperscript{5,6} This study highlights the importance of retaining minimum standards for healthy home temperatures as part of a definition of fuel poverty, as the results suggest that although consumers using prepayment metering report sub-optimal thermal comfort levels across the board, the indoor environments of households with children are even less satisfactory.

Policies to address fuel poverty should include at minimum: extension of energy efficiency retrofitting of housing and heating appliances with specific targeting towards fuel poor households; improvements in the private rental housing stock which should include the introduction of a mandatory housing ‘warrant of fitness’ as suggested by the Children’s Commissioner’s Expert Advisory Group on Child Poverty;\textsuperscript{37} and protections for consumers using prepayment metering to pay for electricity, who are at particular risk of the effects of fuel poverty.\textsuperscript{31}

In addition, significantly reducing fuel poverty in New Zealand is likely to require regulation of the domestic electricity market to better protect low income consumers. Measures that may be required include alternative tariff structures, for example progressive pricing,\textsuperscript{2} and implementing minimum requirements for smart-metering technologies.\textsuperscript{31} Furthermore, targeting households with children who use prepayment metering may be justified as this study shows that within this already deprived population, households with children are especially vulnerable.
Competing interests: Nil.

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References:


