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Heating practices and self-disconnection among electricity prepayment meter consumers in New Zealand: A follow-up survey

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ABSTRACT

This paper presents results from a twelve-month follow-up postal survey of 324 respondents who previously participated in a 2010 nationwide postal survey of prepayment meter consumers. We investigated changes in patterns of self-disconnection and explored heating practices. Self-disconnection decreased from 52.6% to 45.4%, while the frequency of self-disconnection increased slightly. The findings indicate that self-disconnection remains problematic and potentially harmful for many prepayment consumers over time. Self-rationing electricity, particularly restriction of heating is common; 57% of respondents agreed prepayment encouraged restriction of heating use. We provide policy recommendations related to prepayment metering in New Zealand based on these findings.

1. Introduction

1.1. Background on fuel poverty and thermal comfort

Fuel poverty is commonly defined as the inability to afford adequate household energy, including heating to levels recommended by the World Health Organization (WHO), based on required energy expenditure exceeding 10% of household income (Boardman, 1991). Recent debate over the implications of the 10% income threshold on measurement and monitoring (see for example Hills, 2012; Liddell et al., 2011; Moore, 2012; Waddams Price et al., 2012) do not negate the urgency for investigating fuel poverty or developing policies to mitigate its extent and effects.

Temperature ranges and thermal comfort are relevant to defining fuel poverty. For the past 30 years, the WHO has recommended maintaining indoor air temperatures of 18–24 °C to protect health, based on evidence that indoor temperature levels outside this range have detrimental physiological effects (Ormandy and Ezratty, 2012; World Health Organization, 1987). In particular, temperatures below 16 °C are harmful to respiratory health, temperatures below 12 °C have cardiovascular effects, and temperatures below 6 °C increase risk of hypothermia (Collins, 1986; Marmot Review Team, 2010). The 18–24 °C temperature range is generally accepted as the range at which thermal comfort is achieved and sedentary, healthy people, wearing adequate clothing, avoid physiological stress (Collins, 1986; Healy and Clinch, 2002). Use of the term 'thermal comfort' is complicated by the interpretation of the word 'comfort' by different disciplines, which may not translate to a healthy temperature range.

While the use of the WHO temperature range in defining fuel poverty has been questioned (Hills, 2012), recent evidence supports this recommendation (Liddell and Morris, 2010; Marmot Review Team, 2011; Ormandy, 2009). For example, living in homes with a living room temperature of less than 21 °C for at least 9 h per day has a direct effect on the health of patients with Chronic Obstructive Pulmonary Disease (COPD), a respiratory condition (Osman et al., 2008). Improving heating appliances and raising indoor temperatures has both health and social benefits, reducing the respiratory symptoms of children with asthma, and days off work and school (Free et al., 2010; Howden-Chapman et al., 2008).

Assessing fuel poverty in a population setting is difficult as it requires information on the contributing factors: income, housing

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efficiency, energy costs, and indoor temperature. However, previous studies have used subjective measures of thermal comfort, such as self-reported thermal discomfort or responses to cold strain (such as shivering), in order to approximate inadequate indoor temperatures or fuel poverty (Ormandy and Ezratty, 2012; Healy and Clinch, 2002; Ormandy, 2009). Shivering is a physiological thermoregulatory response that increases metabolic heat production (Launay and Savourey, 2009). The temperature at which shivering occurs differs across populations as physiological responses to cold vary with factors such as body mass, age, and diet (Launay and Savourey, 2009; Collins et al., 1977). Repeated exposure to cold temperatures can induce physiological adaptations, changing the temperature threshold at which an individual may experience shivering (Launay and Savourey, 2009; Bruck et al., 1976). However, it is unclear whether repeated exposure to cold, but not extremely cold, indoor temperatures at home are enough to induce these changes (Collins, 1986). Nevertheless, experiencing cold strain severe enough to induce shivering indoors is unlikely to occur at healthy indoor temperature levels.

One Irish study, which used both self-reported indicators of thermal comfort and objective measures of fuel poverty, found that 56.6% of fuel poor households reported shivering indoors compared with 15.8% of other households (Healy and Clinch, 2002). Fuel poor households were 6.7 times more likely to experience shivering for 11–30 min than other households, and 84.4% of the other households that reported shivering did so for a very short period (1–10 min). Fuel poor households were also more likely to live in colder homes with temperatures below the WHO recommendations than other households. The WHO LARES study found significant associations between self-reported thermal discomfort and self-reported health conditions and disease occurrence (Ormandy, 2009).

1.2. The New Zealand setting

New Zealand is a temperate country that experiences high rates of excess winter mortality and fuel poverty (Davie et al., 2007; Hales et al., 2010; Howden-Chapman et al., 2012). Due to the poor quality of the building stock and common use of expensive and inefficient electric heating, many households fail to achieve thermal comfort, and low indoor temperatures are a common phenomenon even in the far North (Howden-Chapman et al., 2012). National average winter living room temperatures are under 18 °C, and bedroom temperatures are under 14 °C (Howden-Chapman et al., 2009; Isaacs et al., 2006). A study investigating the efficacy of a Government-sponsored energy efficiency retrofit in 100 state-owned houses in Dunedin, a city in the South Island with an average annual temperature of 11 °C, found that occupants were exposed to indoor temperatures below 12 °C for almost half (48%) of any 24 h day over the three-month winter period (Lloyd et al., 2008). Fuel poverty rates in the same city were similarly estimated to have reached almost half (47%) of households in 2008 (Howden-Chapman et al., 2012).

In New Zealand, electricity is the predominant form of energy; therefore electricity access and pricing are important drivers of fuel poverty (Howden-Chapman et al., 2009). Reliance on electric space heating continues to rise; according to the 2013 Census, 79.2% of households used electric space heating, compared to 74.8% in 2006 and 72.0% in 2001. However, many of these homes also use wood, gas, or coal for heating fuel (Statistics New Zealand, 2013).

One group at particular risk of fuel poverty consists of those purchasing electricity through prepayment metering, a form of payment where the meter is credited in advance of electricity usage (O'Sullivan et al., 2011). There are many potential advantages to using prepayment, including the ability to monitor and control (or reduce) consumption, manage household budgets, and avoid debt (Coutard and Guy, 2007; Faruqui et al., 2010). However, these are tempered by several potential disadvantage which include: increased transactional costs, including time and travel to outlets to purchase credit; increased pressure on households already experiencing financial hardship and other bill stress, which contribute to poor mental health outcomes; and the inconvenient and potentially harmful outcomes of "self-disconnection" or running out of credit and going without electricity (O'Sullivan et al., 2013a; Sharam, 2003). The term "self-disconnection" refers to the service being shut off when a prepayment meter runs out of credit. While presuming, perhaps incorrectly, that the consumer has agency to freely make the choice to disconnect, the term is widely used and understood so we use it here.

We undertook a multiphase mixed methods research programme to investigate the advantages and disadvantages of prepayment metering for electricity from a consumer perspective (O'Sullivan, 2013). The four phases of the research included (1) a price comparison (O'Sullivan et al., 2011), (2) a nationwide postal survey (O'Sullivan et al., 2013a), (3) an integration of survey datasets to explore outcomes specifically for prepayment households with children (O'Sullivan et al., 2013b), and (4) a study using in-depth interviews (O'Sullivan et al., 2014). Key findings from the nationwide survey were that more than half of prepayment consumers had self-disconnected in the previous year, with 38% of those who had self-disconnected living without electricity for at least 12 h during the past self-disconnection event (O'Sullivan et al., 2013a). Some retailers have suggested that self-disconnection is not problematic or harmful and is largely overcome after a 'learning period' when consumers adjust to using the prepayment system. However, although disconnection rates are regularly monitored and reported for post-payment electricity consumers, no longitudinal information on self-disconnection is available in New Zealand. This research aimed to assess patterns of self-disconnection over time through a follow-up survey of the original cohort.

Given the high rates of self-disconnection found, it is important to assess the heating practices of those using prepayment metering, who will often use electric space heating to maintain indoor temperatures and may therefore be without heating during a self-disconnection event. Additionally, the typically low levels of electricity consumption by prepayment meter users found in international studies (Colton, 2001) implies limited opportunity for electricity conservation, and that consumers who rely on electric space heating will turn to this area for savings. Other studies have indicated that In-Home Displays, which are usually included as part of the prepayment metering systems in New Zealand (and elsewhere), may encourage reduction of essential energy use to unhealthy levels (Buchanan et al., 2015). This is consistent with findings from our interviews, where we found that sociotechnical interactions with prepayment meters and IHDs encouraged severe restriction of space heating even in cases when electricity self-disconnection was avoided (O'Sullivan et al., 2014). While this might be useful for managing finances, and for potentially lowering emissions from electricity generation, reducing heating in the context of New Zealand's already cold indoor temperatures might also pose a significant health risk. The present study explored subjective indicators of thermal comfort and heating practices in order to clarify whether and why prepayment consumers are exposed to unhealthy indoor temperatures. The remainder of this paper details the results of a follow-up postal survey of prepayment electricity consumers. We provide discussion of the broader implications and recommendations for policy.

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