International Conference on Improving Residential Energy Efficiency, IREE 2017

“It’s not too bad” - The Lived Experience of Energy Saving Practices of Low-Income Older and Frail People

Nicola Willand*, Cecily Maller*, Ian Ridley*

*Royal Melbourne Institute of Technology (RMIT) University, 124 La Trobe Street, Melbourne, 3001, Australia
City University of Hong Kong, 88 Tat Chee Ave, Kowloon Tong, Hong Kong, China

Abstract

Drawing on evidence from a mixed methods retrofit intervention trial of the homes of low-income, older and frail people in Victoria, Australia, this study explored practices of heating and keeping warm in terms of equity and health. In most homes, heating restrictions led to inadequate indoor temperatures. Adaptation practices increased householder resilience, however, some technical responses presented safety risks. Low-cost retrofits did not eliminate underheating and had little effect on householder practices. The study highlights that a promotion of no-cost energy saving activities acknowledges the adaptive capacity of individuals. However, failure to address material and technical conditions and the vulnerability of older people may lead to unintended health risks.

© 2017 The Authors. Published by Elsevier Ltd.
Peer-review under responsibility of the scientific committee of the International Conference on Improving Residential Energy Efficiency.

Keywords: social practices; health; equity; coping; behaviour

1. Introduction

This paper addresses simple ways of saving energy and keeping warm in the home of low-income older and frail people and their meanings for a transition towards a low carbon and equitable society. A common policy approach to lower carbon emissions from the residential sector and to reduce the burden of energy costs is to encourage householders to engage in individual, voluntary low-cost and no-cost energy saving actions [1], however the lived

* Corresponding author. Tel.: +61-3-9925 2230; fax: 61-3-9925 1939.
E-mail address: nicola.willand@rmit.edu.au
experience of such actions is underresearched. In the Australian state of Victoria recommended low-cost technical energy saving actions are added ceiling insulation and draught proofing [2, 3]. However, low-income households and tenants, who are more likely to live in homes with sub-standard thermal performance, often lack the financial resources and agency needed for such retrofits [4, 5]. Rebates only address small energy improvements of homes [6], and tenants are not protected by mandatory standards for the energy efficiency of rental properties [7].

General no-cost behavioural energy saving activities encouraged by state and local governments include the temporal and spatial restrictions of heating and the layering of clothes in winter [2, 3]. However, opinions on how these no-cost activities should be interpreted are divided. Some scholars support such activities as opportunities to save energy. They argue that the reliance on active space conditioning and the shift towards thermally homogenous spaces disregard the adaptive capacity of people and their diverse perceptions of comfort, e.g. [8, 9]. By contrast, researchers who explore the daily life of fuel poor households on the premise that achieving ‘warm homes’ should be a public health goal, describe the same ways of saving energy and keeping warm as regrettable coping and adaptation responses to unsatisfactory situations, e.g. [10, 11]. The difference in interpretations raises the question of fairness in efforts to meet the challenge of emissions reduction.

Social practice research is useful in the evaluation of the assessment of equity and health outcomes of such energy conservation activities, as it acknowledges that energy consumption is not only the outcome of individual behaviour, but also shaped by material, social and cultural contexts [12, 13]. ‘Behaviour’ is seen as the observable performance of a practice in a particular moment in time, whereas ‘practice’ refers to the recognisable entity that is performed repeatedly across space and time, and which is comprised of the interacting elements of material, meanings and competences [14]. Practices are dependent on or intersecting with other practices, forming so-called ‘bundles’ [14]. Walker argues that the value judgment of practices in terms of equity should rely on the capability of householders to enact the practice and to function to their optimal potential [15]. This approach requires a good understanding of the preconditions of practices, their meanings to householders and an evaluation of their outcomes. Hence, to enable the interpretation of ‘behavioural’ no-cost energy saving advice in terms of applicability, soundness and equity, research is needed on how such practices are shaped, how they may influence health as an integral part of daily functioning, and how these practices may shift (or not) after low-cost technical retrofits.

A recent residential energy efficiency intervention trial conducted by the South East Councils Climate Change Alliance (SECCCA), provided the opportunity to explore the lived experience of household energy saving practices and to reflect on them in terms of health and social equity. This study had three aims: firstly, to identify practices of heating and keeping warm among a sample of low-income, older and frail people and to describe how these were shaped; secondly, to appraise these practices in terms of health and equity; and lastly, to explore if and why these practices had changed after a low-cost retrofit intervention that did not include behavioural advice.

2. Method

This paper is based on the so-called Health Study, which supplemented the retrofit intervention trial of SECCCA’s Energy Saver Study (ESS). The ESS targeted low-income older or frail householders living independently near Melbourne to investigate the effectiveness of various methods in helping manage domestic energy use. The participating councils recruited participants through their Home and Community Care (HACC) services. In the context of the Energy Saver Study, ‘low-income households’ loosely described households with an income in the bottom 40 per cent of the national income distribution, people who were socially disadvantaged, received financial governmental support or HACC services or were recognised as experiencing fuel hardship. Householders were promised at least AU$500 of energy saving home improvements for participating in the ESS. This paper focuses on the analysis of the conditions and householder experiences during the pre-intervention winter months June, July and August in 2014 and post-retrofit in 2015. The retrofits took place in autumn 2015.

The Health Study was a quasi-randomised controlled trial. Householders in the Health Study belonged to the two ESS study groups of ‘retrofit only’ and ‘control’. No behavioural advice was given. The intervention households received R4 ceiling insulation and draught proofing valued around AU$2500 free of charge. The control group received retrofits worth AU$500 at the end of the data collection period. The Health Study accompanied 16 intervention and 13 control households. One control household left the study due to the sale of the dwelling.
The Health Study employed a mixed methods approach for the purpose of complementarity. Building audits established dwelling construction characteristics. The half-hourly monitoring of living room and bedroom temperatures by HOBO data loggers facilitated the identification of underheating periods for risk assessment. Living room and bedroom temperatures were standardised to ‘average’ winter days with a daily mean outdoor temperature between 9–11°C. Based on international recommendations for the adequacy of indoor temperatures for vulnerable people and assumed occupancy of the rooms, underheating in the bedrooms referred to the time period with recorded temperatures below 16°C [16] during sleeping hours (10.00pm - 7.59am) and in the living rooms to the time period with recorded temperatures below 18°C [17] during awake hours (8.00am - 9.59pm).

Half-hourly electricity consumption for various subcircuits on the dwellings’ switchboards and half-hourly total gas consumption were measured by Ecofront monitors. Monitored gas and electricity consumption data was also used to standardise mean daily consumption indices, taking into account the dwellings’ various fuel mixes. The difference in the changes between the two study groups were tested statistically by non-parametric Mann Whitney U-tests.

Interviews took place at the end of winter/ beginning of spring of each year. Householder questionnaires collected standardised data on coping and adaptation practices that had been pre-identified through a review of the literature. Additional qualitative data were collected through semi-structured interviews on daily heating routines and other practices of keeping warm. The interviews were transcribed verbatim and analysed heuristically in the qualitative analysis software NVivo11. The nodes reflected the reduction of the data to descriptions of the subcategories of heating and adaptation practices.

In the Health Study sample, the majority of the homes were detached houses (control group 85%; intervention group 94%) and owned outright (control group 92%; intervention group 69%). Most of the homes had brick veneer external walls (control group 62%; intervention group 52%) and concrete slabs on the ground (control group 77%; intervention group 63%). All homes had single glazed windows in either aluminium or timber frames. The average house size was similar for the two study groups (control group 144.2±67.5m²; intervention group 130.6±66.5m²) and all homes had at least two bedrooms. The main heating systems were ducted forced-air central heating (control group 54%; intervention group 50%), gas room heating (control group 46%; intervention group 31%) and portable electric heaters (control group 0%; intervention group 19%). Most homes had some ceiling insulation (<110mm: control group 85%; intervention group 81%), although the visual inspection revealed gaps in the coverage. Insulation levels in the walls were mostly unknown.

The participants were single or couples with predominantly Anglo-Australian background, all having lived in Australia for at least 20 years. At least three quarters of main respondents in the study were women (control group 85%; intervention group 69%) and over 70 years old (control group 77%; intervention group 88%). The large majority of participants were retired (control group 92%; intervention group 94%). Consequently, in most homes, someone was at home at all times. The large majority of main respondents had a long-standing illness, disability or infirmity (control group 77%; intervention group 94%). Hence, the sample population was considered vulnerable. The combination of low income and the poor thermal quality of the dwellings suggested fuel stress and possible exposure to low temperatures. The age of the householders and the prevalence of chronic diseases suggested sensitivity to cold. Adaptive responses to heating costs and exposure to cold may have mitigated householder vulnerability.

3. Results

All householders engaged in one or more no-cost energy saving practices that are also recommended by state and/or local government bodies. This paper focuses on four such recommended practices: turning off the heater overnight [3], keeping the thermostat setting between 18-20°C [2, 3], heating only occupied rooms [2, 3], and

---

1 The HOBO UX100-3 Temp/RH data loggers had an accuracy of ±0.21°C and a resolution of 0.024°C at 25°C (Onset Computer Corporation, 2015). The data loggers had been placed by SECCCA staff about 2 metres above the floor, on internal walls and away from heating and cooling devices or outlet.
putting on extra layers of clothing [2, 3]. Where extracts of the interviews are reproduced, pseudonyms are used to protect the anonymity of the participants.

3.1. Turning off the heater overnight

As a common practice, the heating was turned off overnight in all but two homes. Householders referred to the cold in the mornings as “the chill” or “the bite”, a phenomenon that was not considered unhealthy, just uncomfortable. In response, householders had adopted other practices to keep them warm. Many householders reported that they would get up in the morning and switch on the heater on the way to the toilet or to take their medication, and then to go back to bed until the house had warmed up. Some made themselves a cup of tea to take back to bed, some fell asleep again and rose later when the house was warmer. These adaptations reduced their exposure to cold by two to three hours. Participants accepted these adjustments with self-effacing humour.

I think, the coldest part is around about 5 to 7 in the morning. We got to trot out to the toilet. [laughs] Old people.[laughter] So, when round about 4 or 5 o’clock, we’ve got to trot out there, I turn that heater on to low. We don’t put it on high, just to take the bite out of the air. [...] Sometimes, we’d sleep through till about 8. We get a bit lazy. [laughter] (Larry, 83, diabetes, heart problems, cancer)

However, these adaptation strategies did not benefit all participants. In households, where the healthier partner got up early and started the daily chores while the house would warm up for the frailer partner, the healthier partner was exposed to the full duration and intensity of the cold. Warmth in the morning was regarded as being beneficial to mental health, giving householders whose mood was subdued due to illness the “courage” to face the day.

Because of the low morning temperatures, householders looked for other technical means to heat the house quickly, even if the means potentially harmed their health. In one household, the central ducted heating system was switched on for an hour to warm up the house, although it triggered asthma symptoms. In another household, an unflued gas heater was used to warm the kitchen. The householders defended the known health risk of the fumes, which exacerbated the wife’s chronic respiratory condition, by stressing that the appliance was only used for a short time and by praising its capacity to heat the room quickly. To mitigate the chemical air pollution, the kitchen window was kept slightly ajar, which inhibited the benefits of heating.

The heating was kept on overnight only in two households with central heating. In the first case, the single householder had experimented to find the temperature setting that afforded her “courage”, comfort and adequate muscle function to move about safely when she got out of bed. In the second house, automation of the heating ensured that the house was warm when the householders got up in the morning.

The practice of switching off the heater overnight persisted over the course of the study, firstly because most householders had never experienced or considered any other heating pattern in their lives, and secondly, because of concerns about fuel costs even after the retrofit:

I haven’t done it yet, because I - I’m frightened, because I’m thinking, ‘oh my God’, I never left a heater on all night at all yet. [...] but you know, when I’m feeling very generous with myself, well, I’ll do it. (Beatrice, age 89, recipient of retrofits and a new reverse cycle air conditioner)

Based on 12 living rooms and 12 bedrooms with valid pre-and post-retrofit data, the intervention did not eliminate or statistically significantly reduce underheating in either room on ‘average’ winter days (living room: control group (n=5; mean reduction from 264min to 258min; mean rank 7), intervention group (n=7; mean reduction from 116min to 64min mean rank 6.14), U=15, z= -0.424, p=.755; bedrooms: control group (n=4; mean reduction from 293min to 285min; mean rank 8.62), intervention group (n=8; mean reduction from 338min to 281min; mean rank 5.44), U=7.5, z= -1.573, p=.154)). As the low-cost retrofits did not achieve insulation levels that could retain sufficient warmth in the home after the heating was switched off overnight, even intervention homes were still temporarily underheated in the mornings of the follow-up year. In 67 per cent of the 24 living rooms with valid data, temperatures dropped to levels below 18°C during awake hours (control group 73%; intervention group 62%). Seventy-five per cent of the 24 bedrooms with valid data presented temperatures below 16°C during sleeping hours (control group 64%; intervention group 85%), which may have presented a health risk. The coldest times on
'average' winter days were at 6am with means of 15.6(±2.2)°C in the 24 living rooms and 15.3(±2.1)°C in the 24 bedrooms. However, only 17 percent of householders felt that they were unable to heat their homes adequately.

### 3.2. Keeping the thermostat setting between 18-20°C

Asking householders to keep the thermostat setting between a defined range presumes that heating systems have controls that refer to temperatures, that the temperature at the location of the thermostat is a good representation of the whole house and that householders feel comfortable with that setting. However, these assumptions were seldom encountered in this sample. Instead, the capability of enacting this practice was dependent on the characteristics of the heating system and the cold sensitivity of the householders. Whereas all householders with central heating could cite the temperature settings that controlled the warmth in their home, only two households with space heaters referred to temperatures when describing the setting on their appliances. In the centrally heated homes, the thermostats were set at the recommended level of 19-20°C in eight of the 15 homes, although not everyone felt comfortable with the warmth this afforded. One householder admitted to compromising on warmth out of concern about fuel costs and downplayed the discomfort she felt as a consequence:

> Well, it’s quite comfortable. I usually set it on twenty, which isn’t really warm enough to really keep you warm but with — if you put another cardigan on, it’s not too bad. ’Cos they tell me, um, every degree over twenty, it really becomes expensive. (Karen, 75, Parkinson’s disease)

In the remaining seven homes, householders reported settings up to 24°C. In most households, the setting was seldom adjusted, and the heaters were simply turned on and off as “that’s the setting that works for me”. Where heating during the night was practiced, the thermostat was set to 16°C at night. One householder reduced the night setting of the thermostat in the hall after the retrofit by 2°C. The monitored data concurred with her perception that this downward adjustment did not compromise the warmth in her bedroom overnight.

Among the homes with room heating, only two households used the thermostat display to adjust the warmth in the room, turning it onto 24°C in the mornings and, once the room had warmed up, down to 20°C or 22°C. The other appliances had been fitted with sliding controls, and householders had a vague idea about the setting, for example, “low”, “one bar”, “medium” or “three-quarters on the gradient”. However at the baseline, the setting was unknown in eight of the 15 households with room heaters, and householders simply switched the heaters on and off.

The higher than recommended temperature settings were explained by the frailty of the cohort. Feeling colder with age was a recurring theme, as householders felt that they had become more cold sensitive with age, attributing this transformation to thinner skin, blood thinning medication and reduced mobility. In most homes, the heating practices were determined by the requirements of the least healthy person. In this sample, most husbands were frailer, thinner and more sensitive to cold than their wives. The heating levels were adjusted to their requirements, although in several cases even the combination of generous heating, sitting right in front of the heater and wearing several layers of clothing could not warm them up sufficiently to achieve comfort.

In centrally heated homes the common provision of a single thermostat for the whole house could lead to unevenness in temperatures throughout the house and to energy waste. Thermostats of the central heating systems were located either in a passageway or in a central position in the open plan living/kitchen areas. Levels of temperatures in other rooms differed, and householders had difficulties to achieve comfortable conditions throughout the house. In one home, temporary exposure to cold in the toilet regularly led to turning up the living room thermostat for the entire house. In another home, leaving the door open for the dog in the room in which the thermostat was located resulted in temperatures above 24°C in other rooms, which could be interpreted as a waste of energy.

A change in the daytime room heater setting over the study period was only reported in one control home in which the husband, who had been very cold sensitive, had died. The widow felt comfortable at a lower setting. However, underheating of the room for 7.5 hours during the day may have presented a health risk.
3.3. Heating only occupied rooms

Heating only occupied rooms was the only possible heating practice in homes equipped with only a living room room heater, but not an option in homes with central heating. The spatial restriction of heating satisfied the objective of saving energy. Centrally heated homes (n=14) used almost three times as much heating energy as homes with a room heater (n=14) on ‘average’ winter days (mean at baseline: centrally heated homes 302.4 MJ, room heated homes 125.8MJ; mean at follow-up: centrally heated homes 316.9 MJ, room heated homes 119.8MJ).

However, the spatial restriction of heating was bundled with practices aimed at keeping the warmth within the heated room and keeping warm in bed with potentially harmful consequences. Blocking the gap below internal doors to prevent draughts and involuntary air exchanges between the heated living area and the rest of the house was a common practice. Whereas a ‘sausage’ or ‘snake’, i.e. a removable textile tube, was considered socially acceptable, a piece of textile was not and was removed to avoid embarrassment. Both alternatives presented tripping hazards for this population group. Indirect heating by opening up doors to bed or bathrooms was only practiced once the main room had heated up, only in the evenings and only if the rooms were adjacent, so that most non-heated rooms were described as cold. Sharing a bed with dogs to keep warm was reported in three households, a practice that may have advantages for wellbeing and disadvantages for physiological health [18].

Heating only the living room also led to a marked unevenness of temperatures throughout the home, that is, the difference between living room and bedroom, which may present a threat to health in this population group [19]. The intervention did not statistically significantly reduce this potential health risk (control group (n=4; reduction from 2.28°C to 2.10°C, mean rank 6.67), intervention group (n=7; increase from 1.50°C to 1.55°C, mean rank 5.57), U=11, z= -0.567, p=.648). The unevenness, which reached a maximum difference of 8°C on ‘average’ winter days in one home, was most marked in the evenings, when householders would have shed insulating layers of clothing in preparation for bed.

Several householders subconsciously modulated the meanings of the lack of warmth in their bedrooms by minimising or rationalising the cold. The independent acquisition of new heating devices over the course of the study revealed that statements, such as not needing warmth in the bedroom, “it’s sometimes a bit cool”, and “we can, probably, manage without it” were expressions of psychological adjustments to a challenge that the householders were unable to solve. Achieving temporary warmth in rooms without a fixed heater required the use of portable electric devices that were expensive when used for an extended period of time, and which could present an electrical hazard in wet areas. Bathrooms tended to be particularly cold and were described as “freezing” or as the “coldest room in the house”. Portable electrical fan heaters provided comfort, but the householders’ health and safety was put at risk when the electrical devices were placed too close to water taps.

In centrally heated homes, technical aspects prevented the spatial management of heating. Two householders had been told by the installers that closing several floor vents would be unsafe and inefficient. In one control home, the householders had investigated the possibility of isolating the unused, but always warmer, upper storey to reduce the onerous heating costs. However, the high capital cost proved a problem. In a very new house, the only one with zoned ducted heating, closing off one zone was not practiced, as it resulted in unacceptably strong air currents from the remaining open vents that would “blow everything off the table”. A change in the spatial extent of heating was only observed in one home, where the independent installation of a reverse cycle air conditioner in the living room afforded switching off the central heating system that used to heat the unoccupied upper storey.

3.4. Putting on extra layers of clothes

All householders adjusted their clothing level in winter. Some householders put in extra effort to cope with restricted heating due to fuel poverty or heightened cold sensitivity. Participants mentioned items such as jumpers, extra cardigans, singlets, fleecy clothes, flannelette shirts, thermal underwear, long johns, “fluffy tracking pants” and the occasional use of a coat. One lupus patient, who could not heat her home to her satisfaction due to financial constraints, resorted to wearing gloves inside. Two men around 90 years of age wore knitted hats at night.

Another household explained that for people with a mobility disability, taking off layers was easier than redressing completely. A fleece poncho with side slits removed the difficulty of reaching up or sideways with the arms, as necessary when putting on jumpers or cardigans. However, her perception of social acceptance and pride
prevented her from putting it on while entertaining guests. Householder comments, such as “everybody says I am overloaded”, “[laughs] I’m like the Michelin woman” or “they’re not exactly elegant, but I don’t care [laughs]”, expressed that some householders felt like misfits due to the extent of their clothing response to indoor cold. Some participants experienced difficulties in achieving bodily warmth despite heating and extra clothes due to age and/or illness – a perceived oddity that was embraced with humour by themselves and their partners:

And I’ve always said to him, if he has got to go to a hospital, they’d never get to his body with all the clothes he’s got on. [laughter] he’d die. (Emily, 85, about her husband, 76, cardio-vascular problems)

The interviews revealed a subtle shift towards more clothing. Two octogenarians from intervention households had taken to wearing singlets and flannelette shirts in the second winter due to increased cold sensitivity.

4. Discussion and conclusion

This paper explored the lived experiences of low-income older and frail householders who performed no-cost energy saving practices that are recommended by government institutions, appraised them in terms of equity and health, and reported changes attributable to the low-cost technical interventions from a retrofit program. The capability to engage in these practices depended on the technical characteristics of the heating system, the comfort of the most cold sensitive householder and the meanings of heating and warmth. Practices that restricted heating were common but led to indoor temperatures below recommended levels for this population group. Subsequent adaptation practices moderated householder exposure to cold and modulated thermal discomfort, thus increasing householder resilience, however some of the technical aspects of the adaptation practices presented safety and health risks. The low-cost retrofits did not eliminate underheating and had little effect on householder adaptation practices for keeping warm. Despite the low-cost retrofits, householders continued to engage in their routines to save energy because these were established life-long practices and/or due to financial constraints, and thermal conditions that may be interpreted as harmful from a medical perspective persisted. The study found that the general recommendations to save energy reinforce individual responsibility, yet that the material and technical conditions of homes may inhibit the applicability of the advice, that already established restrictive heating practices may hinder their effectiveness, and that householder susceptibility to cold and potentially harmful technical responses may call into question the soundness of the advice.

Although the study was limited by the small number of participants and valid indoor temperature data, and the findings may not be generalised beyond the specific population group of older and frail householders living in Victoria, Australia, the relevance of the study lies in its implications for “imaging and realising versions of normal life that fit within the envelop of sustainability and that are resilient, adaptable and fair” [20].

The restricted heating and adaptation practices encountered in the homes of this study may be interpreted as positive models of saving energy and building resilience. As deliberate, non-constraints-related heating restrictions and indoor cold are not uncommon phenomena in the temperate climates of Australia, e.g. [21-23], the exposure to cold and uneven temperatures may be interpreted as avoidable, but not necessarily unfair or inequitable.

However, Chard and Walker [24] caution that householders’ lack of problematising indoor cold may overlook the exposure to potential health risks. Older and frail people are particularly vulnerable to cold [19]. Evidence of the effectiveness of warmer clothing is scarce [25]. Health risks from cold homes are not restricted to low body temperatures, but include cold air breathing, facial cooling and biological air pollution [19]. As householders did not identify these risks, they inadvertently exposed themselves to potentially harmful conditions. Recommendations to limit or restrict heating in homes and to wear more clothing may normalise adaptive responses to problems with energy costs and cold and may hinder the self-identification of vulnerable households [24]. Hence, a policy focus on providing adequate indoor warmth through extensive improvements of building quality and mandatory standards for rental properties may satisfy the demands of energy conservation and health equity better than the universal promotion of individual no-cost energy saving behaviours.

In conclusion, the study highlights that the policy approach of promoting low- and no-cost energy saving advice has to pay attention to the sensitivity of diverse population groups, the meanings of warmth, and the characteristics and the thermal performance of the housing stock to avoid unintended consequences for health. The promotion of individual coping strategies problematically places the primary responsibility upon individuals. However, in order to
improve equity and health outcomes for low-income, older or frail householders, the study suggests that there is an opportunity for policy to play a greater role in tackling material and technical conditions of housing, the affordable improvement of residential energy efficiency, rising energy costs and the protection of vulnerable population groups.

Acknowledgements

The authors thank the South East Councils Climate Change Alliance and the Energy Saver Study team for supporting this research.

References