Evaluation of the Victorian Healthy Homes Program, a randomised controlled trial

Katie Page[1], Kees van Gool[1], Margaret Campbell[1], Thomas Longden[1,2], Patricia Kenny[1], **Lutfun Hossain[1]**, Dan Liu[1], Kerryn Wilmot[3] Scott Kelly[3], Yo Han Kim[3], Philip Haywood[1], Brendan Mulhern[1], Stephen Goodall[1], Rosalie Viney[1], Toby Cumming[4], Matthew Soeberg[4]

[1]Centre for Health Economics Research and Evaluation, University of Technology Sydney, Australia, [2]Crawford School of Public Policy, Australian National University, Canberra, Australia, [3]Institute for Sustainable Futures, University of Technology Sydney, Australia, [4]Sustainability Victoria, Melbourne, Australia

Introduction

Poor housing quality is associated with inefficient energy use, adverse living conditions and increased risk of morbidity and mortality.[1-5] Vulnerable people, particularly the elderly, and those with disability or chronic illness, are at higher risk as they are more likely to spend most of their time at home and therefore, be more exposed to health risks associated with cold homes. They may also not be able to afford heating or measures to improve housing quality.

Previous studies examining the impact of home thermal comfort and energy efficiency (TCEE) upgrades[6-11] have provided evidence that home upgrades increase indoor temperatures and indoor air quality[1] and have the potential to provide health benefits through reductions in hospital admissions[7], decreased wheezing[8], lower respiratory tract symptoms for children with asthma[12], and lower rates of emergency admissions for cardiovascular conditions.[13]

However, results across countries may vary due to differences in climate, the quality of the housing stock and existing levels of energy efficiency,[14] and currently, there is no evidence of health benefits in an Australian context. There is also limited evidence of the economic benefits of home TCEE upgrades within Australia. Recommendations from the WHO report [15] call for further research into vulnerable populations groups who spend more time at home, interventions and policies targeted at raising indoor temperatures and the need to explore a range of health outcomes.

The Victorian Healthy Homes Program (VHHP) is a randomised controlled trial that addresses this evidence gap. The program delivered home upgrades up to the value of $3,500 to 1000 low-income households across the Western suburbs of Melbourne and the Goulburn Valley, where at least one person in the household had a need for home care support services or an existing health condition.

Methods and Analysis

The VHHP was implemented over a 3-year period and used a staggered, parallel group clustered randomised controlled trial to test the home upgrade in 1000 households. The program provided a home assessment and upgrade as recommended following the assessment. Upgrades included curtains, split cycle heating, draft proofing, with the average cost per household being $2780. All households received a home upgrade either before (intervention group) or after (control group) winter (defined as 22 June – 21 September). The primary outcome is the mean difference in indoor average daily temperature between intervention and control households during the winter period. Secondary outcomes include household energy consumption and residential energy efficiency, self-reported respiratory symptoms, health-related quality of life, health care utilisation, absences from school/work and self-reported conditions within the home.

In 2020 lockdowns and stay-at-home orders were applied in response to the COVID-19 pandemic, which saw temporary suspension of home energy assessments and home energy upgrades for the largest cohort in the VHHP. Consequently, not all intervention households received their upgrade prior to the start of winter, which impacted the study's power and sample size, and home visits were changed to telephone interviews which impacted survey data collection. Given these unusual circumstances and the large proportion of the sample affected by it, additional analyses in the form of per-protocol (PP) analysis have been undertaken to maximise the insights gained from the study. Linear and logistic regression are used to analyse the primary and secondary outcomes, controlling for clustering of households by area and the possible confounders of year and timing of intervention, to compare the treatment and control groups over the winter period.

The economic evaluation includes both outcomes and cost data from the primary and secondary outcomes in the intervention and control groups and is both a cost-effectiveness analysis (CEA) and a cost-benefit analysis (CBA). The economic evaluation produces evidence on the benefits of the VHHP. This is compared to the costs of the VHHP minus the potential monetary cost-savings, through reduced health care use and improved energy efficiency. The economic evaluation also measures the downstream health care resource effects for up to one-year post intervention. It estimates longer-term outcomes through modelling techniques which will incorporate economic benefits and potential savings in energy use and health care costs compared with the cost of the home upgrades. The economic evaluation also extrapolates future potential energy savings, considering changes in consumption patterns, prices and depreciation of home upgrades.

Preliminary findings

The analysis of the VHHP is still in early stages but full results will be available before June 2022. A summary of the energy analysis in shown in in Table 1.

The energy data shows households experienced 9.8 hours of cold indoor conditions (below 18°C) per day. A decrease in daily gas consumption was also observed in the intervention cohort. Similar results were not observed in electricity consumption.

	Intention-to-treat analysis	Per-protocol analysis
Reduction in exposure to cold indoor temperatures	41 minutes per day or 62.8 hours over the winter period (p=0.037)	39 minutes or 62.8 hours over the winter period (p=0.094)
Daily gas consumption	23.8 MJ per day (p=0.01)	26.4 MJ per day (p=0.02)
Gas savings	$0.607 per day or $55.83 savings over the winter period	$0.673 per day or $61.93 savings over the winter period

Table 1 Summary of energy findings

Initial analysis of the health data showed a small group effect in that there is a trend that the intervention group has a lower number of MBS services (p=0.079) and charges (p=0.046) than the control group after controlling for age, sex, LGA and cohort. The data also shows a strong cohort effect, such that the 2020 cohort is significantly different to the 2018 and 2019 cohorts. 2020 was an unusual year because of the COVID-19 pandemic and this is clearly observed in the health data. People avoided or were unable to leave their houses and GP appointments were significantly down compared to previous years.

Analysis of the quality of life data also shows that individuals in the intervention group had improved mental health scores (p=0.026) and social care outcomes (p=0.009) than the control group after controlling for age, sex, LGA and cohort.

Conclusion

The evaluation of the VHHP is the first randomised controlled trial of its kind that generates evidence about the efficacy and cost effectiveness of home upgrades to improve thermal comfort, reduce energy use, and produces health and economic benefits to vulnerable households in Victoria, Australia.

Key Words

housing; health; insulation; home upgrades (retrofits), randomised control trial; temperature; thermal comfort; Australia

References

1. Thomson, H., M. Petticrew, and D. Morrison, *Health effects of housing improvement: systematic review of intervention studies.* BMJ, 2001. **323**(7306): p. 187-90.
2. Thomson, H., et al., *The health impacts of housing improvement: a systematic review of intervention studies from 1887 to 2007.* Am J Public Health, 2009. **99 Suppl 3**: p. S681-92.
3. Thomson, H., et al., *Housing improvements for health and associated socio-economic outcomes.* Cochrane Database Syst Rev, 2013(2): p. CD008657.
4. Awaworyi Churchill, S. and R. Smyth, *Energy poverty and health: Panel data evidence from Australia.* Energy Economics, 2021. **97**: p. 105219.
5. Wilkinson, P., et al., *Cold comfort: the social and environmental determinants of excess winter death in England, 1986-1996.* 2001: York.
6. Chapman, R., et al., *Retrofitting houses with insulation: a cost-benefit analysis of a randomised community trial.* Journal of Epidemiology and Community Health, 2009. **63**: p. 271-277.
7. Grimes, A., et al. *Cost Benefit Analysis of the Warm Up New Zealand: Heat Smart Programme*. 2011 2012 June [cited 2021 Mar 23].
8. Howden-Chapman, P., et al., *Retrofitting houses with insulation to reduce health inequalities: Aims and methods of a clustered, randomised community-based trial.* Social Science & Medicine, 2005. **61**(12): p. 2600-2610.
9. Howden-Chapman, P., et al., *Effect of insulating existing houses on health inequality: cluster randomised study in the community.* British Medical Journal, 2007. **334**: p. 460.
10. Preval, N., et al., *Impact of improved insulation and heating on mortality risk of older cohort members with prior cardiovascular or respiratory hospitalisations.* BMJ Open, 2017. **7**(11): p. e018079.
11. Telfar Barnard, L., et al., *The impact of retrofitted insulation and new heaters on health services utilisation and costs, pharmaceutical costs and mortality: evaluation of Warm Up New Zealand: Heat Smart. Report to the Ministry of Economic Development.* 2011: Wellington.
12. Howden-Chapman, P., et al., *Effects of improved home heating on asthma in community dwelling children: randomised controlled trial.* BMJ, 2008. **337**: p. a1411.
13. Rodgers, S.E., et al., in *Health impact, and economic value, of meeting housing quality standards: a retrospective longitudinal data linkage study*. 2018: Southampton (UK).
14. Milner, J. and P. Wilkinson, *Commentary: Effects of Home Energy Efficiency and Heating Interventions on Cold-related Health.* Epidemiology, 2017. **28**(1).
15. World Health Organisation. *WHO Housing and Health Guidelines*. 2018 [cited 2021 March 23]; Available from: https://www.who.int/sustainable-development/publications/housing-health-guidelines/en/.