



Review

Towards explaining the health impacts of residential energy efficiency interventions – A realist review. Part 1: Pathways

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ARTICLE INFO

Article history:

Available online 11 February 2015

Keywords:

Energy efficiency
Housing
Health
Wellbeing
Heating
Evidence
Realist review

ABSTRACT

This paper is Part 1 of a realist review that tries to explain the impacts of residential energy efficiency interventions (REEIs) on householder health. According to recent systematic reviews residential energy efficiency interventions may benefit health. It is argued that home energy improvement are complex interventions and that a better understanding of the latent mechanisms and contextual issues that may shape the outcome of interventions is needed for effective intervention design. This realist review synthesises the results of 28 energy efficiency improvement programmes. This first part provides a review of the explanatory factors of the three key pathways, namely warmth in the home, affordability of fuel and psycho-social factors, and the pitfall of inadequate indoor air quality. The review revealed that REEIs improved winter warmth and lowered relative humidity with benefits for cardiovascular and respiratory health. In addition, residential energy efficiency improvements consolidated the meaning of the home as a safe haven, strengthened the householder's perceived autonomy and enhanced social status. Although satisfaction with the home proved to be an important explanation for positive mental health outcomes, financial considerations seemed to have played a secondary role. Evidence for negative impacts was rare but the risk should not be dismissed. Comprehensive refurbishments were not necessarily more effective than thermal retrofits or upgrades. A common protocol for the quantitative and qualitative evaluation of interventions would facilitate the synthesis of future studies. Householder and contextual influences are addressed in Part 2.

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1. Introduction

In the contexts of climate change mitigation and housing as a determinant of health, the study of the social impacts of residential energy efficiency is gaining interest (WHO, 2008; WHO Europe, 2007; Williamson et al., 2009). Thermal comfort and affordability of fuel are widely regarded as manifestations of housing quality and to be key factors in housing related health outcomes (Marmot Review Team, 2011; WHO, 2008). Several reviews and syntheses on the health impacts of housing improvements intended to provide better warmth and energy efficiency have been published (Liddell and Morris, 2010; Maidment et al., 2013; Thomson et al.,

2001; Thomas et al., 2009; Thomson et al., 2013), concluding that such programmes may benefit householder health.

By contrast to previous syntheses that sought to provide a verdict on the effectiveness, the aim of this realist review was to provide an appreciation of the latent mechanisms and the contextual issues that may have shaped the intervention outcomes. Residential energy efficiency programmes are complex interventions in complex systems. They may include a diverse range of insulation measures and technical system upgrades individually or as a package, and involve a range of actors, funding agencies, researchers, contractors and target populations in specific cultural, social and economic circumstances. Recently published logic models of housing improvements and health outcomes testify to the need to establish 'what works' (Thomson and Thomas, 2015). Hence, the present review took a realist approach and applied "an explanatory rather than judgemental focus" (Pawson et al., 2005, p. 21). The findings provide the evidence for recommendations for

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effective design of REEI programmes and their evaluations. The primary question for the realist review was.

How can health outcomes from residential energy efficiency interventions be explained?

In realist reviews, programme theories denote the hypothesised functioning of interventions and the unintended or unforeseen processes that led to favourable or unfavourable outcomes (Jagosh et al., 2011). In the context of REEIs, programme theories with positive outcomes are referred to as 'pathways', those with negative impacts as 'pitfalls'. This paper represents Part 1 of the realist review, focussing on the pathways, the key mediating factors and the influence of the scope of the interventions. Part 2 reflects on how contextual issues and the householders' situation may have impacted the outcomes (Part 2 to be published separately).

2. Methods

2.1. Search process and document selection

The search and appraisal process, conducted by the first author, was ongoing and iterative. The starting point was a search for primary intervention studies published in online academic databases and the internet in February 2013 using keyword combinations including search terms such as "cold home", "housing", "home", "energy efficiency", "health", "heat stress", "indoor temperature", "intervention", "overheat" and "trial". No publication date restriction was imposed. Alerts were set on selected databases for key terms and authors. Further articles were identified by exploring the references or the cited-by sections of the documents found, in particular of recent reviews on housing improvements and health (Liddell and Morris, 2010; Maidment et al., 2013; Thomson et al., 2001; Thomson et al., 2009; Thomson et al., 2013). This technique proved to be particularly useful in locating low-profile companion pieces presenting findings of qualitative research components of

primary studies. In keeping with the realist review approach, all sources that seemed relevant and promised to add some information on the overall mechanism of the intervention, that is quantitative and qualitative studies, peer-reviewed journal articles and grey literature, were included (Pawson et al., 2005).

The focus of the search was on collecting primary studies that evaluated technical energy efficiency interventions with regards to indoor temperature, affordability, condensation, dampness and mould, health or mortality outcomes. Intervention programmes needed to have been relevant. Data collection methods needed to have been coherent and the findings plausible (Wong et al., 2014). Studies on behaviour change programmes, rehousing, general renovations, financial assistance to householders or with a sole examination of energy consumption outcomes were excluded. Programmes with the primary aim of improving the ventilation of homes were separated as energy efficiency was at best regarded to be of secondary importance. In the appraisal of individual documents, those containing evidential fragments (Pawson, 2006) pertaining to the selected programmes were included. The final collection of studies consisted of 73 documents referring to fourteen UK, four New Zealand, four US, two Irish, two Australian, one Danish and one German programme published between 1986 and 2014 (see Fig. 1).

Data extraction as well as the initial analysis and synthesis was undertaken by the first author. All documents on primary intervention studies were put into a matrix and key characteristics of the programme designs, delivery, target populations, outcome assessment methods and results of physical factors and health indicators were tabulated. Indicators referring to the psycho-social meaning of the home were added later once their importance as mediators became apparent. This matrix provided a useful tool to identify the coverage of variables across studies and to compare assessment method and outcomes. Programmes were then categorised to examine how the scope of measures affected the outcomes. During the synthesis process, the nature and direction of outcomes within and across intervention categories were compared and mapped

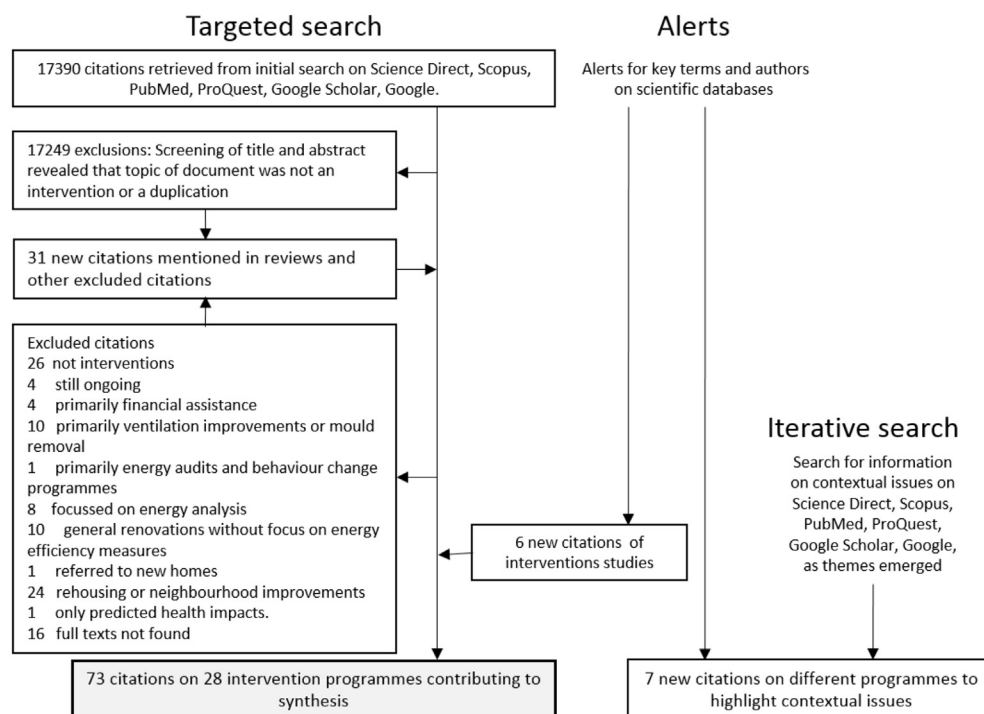


Fig. 1. Flow diagram illustrating the search process and article choices. Please refer to Supplement B for more detail on the search process.

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