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Lessons Learned from Implementing a Programme of Home Modifications to Prevent Falls amongst the General Population

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Received: 15 May 2018; Accepted: 14 June 2018; Published: 20 June 2018

Abstract: Home fall injuries amongst the general population are common and costly. In the Home Injury Prevention Intervention (HIPI) trial, we showed that 26% of medically treated home fall injuries could be prevented by a package of home modifications undertaken by qualified builders. This paper describes how we addressed unexpected safety issues associated with the implementation of the programme. Following the intervention, we ensured that participants could contact the builders. We monitored any problems or issues over a two-year period. We also held public meetings to explain the results of the study and record participants' comments about the trial. Generally, people were satisfied with the modifications. However, there were clear safety issues with particular modifications and we revisited homes to address these. These findings highlight the need to allocate some resources for monitoring and remediation work to follow up interventions, and also a need for some regulation of the quality of safety products.

Keywords: home modification; interventions; fall injuries; implementation

1. Introduction

Injuries from falls pose a major health burden worldwide. Home modification has been considered a likely effective measure to prevent falls, although its effectiveness has been poorly studied amongst the general population [1]. Recently, the Home Injury Prevention Intervention (HIPI) study in New Zealand evaluated the safety benefits of home modifications in preventing falls for the general population via a single-blinded randomised controlled trial [2]. The 26% reduction in medically treated fall injuries (with a 95% CI 6–42%) made the programme highly cost-beneficial, yielding a conservative benefit/cost ratio of at least six. We concluded that the benefit/cost ratio could be at least doubled for older people and increased by 60% for those with a prior history of fall injuries [3].

The modifications tested included handrails for outside steps and internal stairs, grab rails for bathrooms, outside lighting, edging for outside steps, and slip-resistant surfacing for outside areas such as decks and porches. Of 842 households recruited, 436 were randomly assigned to the treatment group and 406 were assigned to the control group, constituting 950 and 898 individuals, respectively. Participants were recruited from lists of people in the Taranaki Region of New Zealand who had recently received government-subsidised home insulation retrofitted to their homes. Modifications were carried out between 2010 and 2011 for the treatment homes, and in 2013–2014 for the control homes once the results

of the RCT (counts of home fall injuries) were available. For the treatment group of 436 houses, the vast majority (81%) needed safety modifications to steps, often in combination with other modifications in bathrooms. Only 24 houses (5.5%) were evaluated by the builder as requiring no modifications. A total of 374 fall injuries were analysed from this study group over 3.1 years. The study team included a building scientist, a public health physician, a clinical psychologist, a health economist, a Māori health researcher, a statistician, and an injury epidemiologist.

The implementation of a programme of home modification is complex and potentially fraught. Not all modifications to reduce risk are acceptable to the occupants. Further, there is always the potential for a modification to increase risk in some circumstances. This paper describes some unanticipated safety issues encountered in the implementation of the HIPI trial intervention, how we monitored these issues, how we addressed them, and some wider considerations around product safety.

2. Materials and Methods

Following the intervention, we ensured that participants could contact the builders if there were problems. Participants had information sheets with contact numbers of the builders and the study team, and the same information was on the study web page. We kept a record of any issues over a period of two years after the last house in the treatment arm was modified. We also held two public meetings with the participants to explain the results of the study and record participants' written and verbal comments about the trial and the acceptability or quality of particular modifications. These meetings were open to all members of the public and were advertised in local newspapers. Invitation letters were also sent to the home addresses of all participants. Around 150 people in total attended the meetings, although no record was kept of who the attendees were. In addition to the public meetings, we telephoned a random sample of 40 participants from the treatment group to make sure that the modifications were being carried out adequately. These were selected using a systematic sample in which every tenth address was sampled. The main question asked was "Can you describe to me the work that the builders carried out on your home?" If the respondents failed to report a modification that we had recorded as being carried out at their home, further questions were asked to prompt their memory. For example: "Did the builders also install strips on the edges of your outside steps?"

Ethical approval was provided by the Central Regional Ethics Committee of the Ministry of Health (reference CEN/09/06/035).

3. Results

Comments were provided in writing by participants at the public meetings. Most participants were happy with the intervention. Frequent comments were made about the failure of outside solar lighting and the suction-cup-attached grab rails. Rare comments about the modifications included: "wooden outside handrail splits in the heat and splinters"; "luminous part of step [edging] has failed"; "strip on concrete step catches feet". From the phone calls made to a subsample of 40 participants, only one problem was reported, which was a loose stair edging. This was repaired shortly afterwards.

Table 1 presents a list of the main safety issues associated with the intervention, both those where an attempt was made to address them, and potential new issues created by poor installation or product inadequacies. Also shown are solutions actually applied and some further solutions proposed.

Table 1. Particular home modifications applied in HIPI study, issues encountered, and solutions applied.

Safety Deficit Addressed in Homes	Modification Used	Number Houses with Modification (N = 842)	Advantages	Issues Encountered	Actual Remedy (*with Further Proposed Remedies in Italics*)
Slippery steps/poor visibility of steps	Edgings (nosings) for outside steps	518	Relatively easy to retrofit: aluminium channels with luminous slip-resistant insert	Some exposed aluminium edges were sharp and presented a cutting hazard	Strips that span the full width of the step; blunting sharp edges. *Regulation of quality of safety features*
Lack of handrails in bath/shower	Grab rails with suction cups	292	Can be installed without interfering with existing tiles or wall surfaces	Failure of suction after a few months	Install grab rail with permanent fixings. *Regulation of quality of safety features*
Poor outside lighting	Solar powered outside lighting	296	Does not require connection to wiring of house, so installation is relatively cheap	High failure rate, potentially from poor weather proofing	A better product, fit for purpose. *Regulation of quality of safety features*
Fire/smoke hazard	Smoke detectors	342	Cheap and quick to install	Battery has expected life of around one year. Occupants often fail to replace battery	None applied. *Detectors with longer battery life* e.g., *10 years*

Safety issues around the modifications installed were initially brought to our attention by participants in the study who contacted us or the builders, who in turn alerted us. As the research team was particularly concerned about new safety hazards potentially generated by the first two items in Table 1, we decided to contact all participants who had received these modifications and remedy the issues where possible.

The product installed on step edgings consisted of aluminium profiles that were screwed to the step edge. Into the channels of these profiles were fitted luminous slip-resistant inserts. To remedy the sharp edges presented by some exposed aluminium casings or channels, one of three solutions was applied: wider edgings were installed that spanned the whole step edge (leaving no exposure to sharp edges); any sharp edges were identified and either flattened or filed to a blunt edge; or rarely, the step edgings were uninstalled.

The grab bars attached via suction cups were replaced where possible with grab bars screwed securely into the wall.

Smoke detectors were included as part of the programme of modifications because they were reasonably cheap to install and provided an important safety benefit [4]. They were not expected to reduce injuries due to falls, however, which was the main outcome evaluated. In participants' homes, a large number of smoke detectors were not operational because of failed batteries, highlighting the likely benefit of installing devices with a longer battery life.

4. Discussion

A limitation of this study is that we did not know whether those participants motivated to attend the meetings and provide comments were representative of the participants overall or whether those either happy with the programme or unhappy with the modifications made might have been overrepresented. Generally, people were satisfied with the modifications and the way they were carried out. However, there were clear safety issues with some modifications and we revisited homes to perform quality checks and modify where necessary. These issues highlight some broader considerations that affect home safety beyond the programme considered here.

In New Zealand, there is a Consumer Guarantees Act [5] that requires a supplier of products to provide a replacement for products used in the fashion for which they are intended that fail within a reasonable period. When a large proportion of the expense of a given modification is the installation,

the Consumer Guarantees Act is not an efficient mechanism to ensure product quality and safety as these products cannot be readily uninstalled and replaced. Some regulation of quality control would therefore make better sense. All electrical products sold in New Zealand, including smoke detectors, are required to meet fundamental safety provisions that provide some assurance of quality control [6]. However, there appears to be no similar regulation for other safety devices (such as grab rails or solar-powered lighting). The failure of a grab rail could lead to a serious injury, particularly for a frail older person who is more likely to lose balance and use the grab bar to prevent a fall. It is therefore concerning that devices such as suction-cup-attached grab rails are sold when they are known to be relatively insecure. Warnings or disclaimers on products (one such warning was "THIS PRODUCT IS NOT DESIGNED TO HOLD FULL BODY WEIGHT") are not reassuring when such products are likely to be relied on when someone loses balance.

If the safety modifications described were to have strong uptake outside of a programme such as described here, concerns regarding the quality of installation need consideration. In New Zealand, there is a tradition of amateur modification of homes. An inexperienced home repairer is less likely to adhere to product installation instructions than a professional tradesperson. A poorly installed safety device may pose a greater hazard than the absence of any safety device. Such considerations support a rationale for a service where professionals assess safety issues and propose modifications, and a tradesperson installs them. Although our study involved the modification of existing housing to increase safety, clearly these safety features should be standard in new dwellings also.

This study involved the general population, but included a large proportion of older people living in the community (more than half were 70 years old or older) [1]. Our participants were recruited from lists of people living in the Taranaki region of New Zealand who had recently received government-subsidised home insulation that was retrofitted to their homes [1]. To qualify for this scheme, houses needed to have at least one occupant who was a holder of a community services card. These cards are held by people on a relatively low income, unemployed individuals, students, pensioners (age 65 years or older), and people in receipt of sickness benefits, and they indicate that the person is entitled to state subsidies. The qualifying criteria—at least in part—explain the high proportion of older people recruited. An effective protocol for reducing falls amongst older community-dwelling people involves an initial home-safety assessment with subsequent modification interventions tailored to the needs of the occupant or occupants [7]. This differs from the approach studied here in that we did not tailor the intervention to the occupants apart from allowing occupants to refuse to have potential modifications done, for aesthetic or other reasons.

5. Conclusions

The implementation of home modifications to prevent injury needs to be closely monitored, particularly when poor installation or inadequate products have the potential to cause injury. Consequently, intervention programme budgets need to allow for a proportion of homes needing revisits and/or further modification. Better regulation of safety products would increase the potential safety benefits and the acceptability of the modifications. Despite some such issues described in the current paper, participants were generally satisfied and the overall programme was highly successful in preventing fall injuries. Lessons learned over the course of four years since the modifications were first installed have helped change our implementation practices in a subsequent study of 250 homes occupied by Māori, the indigenous people of New Zealand.

Author Contributions: M.D.K. designed the trial with input from N.P., M.G.B. and P.H-C. All authors contributed to the conduct of the trial, interpretation of results, and revision and correction of this paper, which was drafted by M.D.K. All authors read and approved the final version of this paper.

Acknowledgments: The trial was funded by the Health Research Council of New Zealand.

Conflicts of Interest: The authors declare no conflicts of interest.

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