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The contribution of dwelling design in accident prevention

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Abstract

Accidental home-based injuries are a significant health and safety concern worldwide. Each year in the EU approximately 20 million home and leisure accidents occur and more than half of these incidents arise in or around the home. Within the United States, one fifth of fatal unintentional injuries occur within the home environment. The careful design of dwellings can help minimise the risk of injury or ill-health and this has been recognised in the development of building control in a number of countries. This research examined the interaction between dwelling design and occupier behaviour in the safety of new dwellings. In-depth semi-structured interviews were conducted with individuals recently inhabiting a new home. Participants reported unsafe behaviours which arose through their interaction with building features. These findings were presented to architects responsible for dwelling design within the UK. The architects placed responsibility for health and safety with the occupiers themselves. In terms of preventing unintentional injury through design, architects reported that they were limited in what they could do. The results from this study identify a need for a multi-disciplinary approach to home accident prevention with a need for clear communication of research findings to those in commercial practice.

Keywords: design, home safety, behaviour, building control

1. Introduction

Unintentional home-based injuries are a significant cause of death and injury here in the United Kingdom and abroad. Each year within the UK, almost 4,000 deaths occur as a result of a home accident and over 2.7 million individuals sustain injuries within the home which require some form of medical attention.\cite{1}. In the EU, approximately 20 million home and leisure accidents occur resulting in some 2 million hospital admissions and over 80,000 deaths. Over half of these incidents occur in or around the home\cite{2}. Within the United States, unintentional injuries are a leading cause of death with one fifth of all fatal unintentional injuries occurring within the home environment\cite{3}. These figures demonstrate that unintentional home injuries are a major world wide public health concern and despite a number of initiatives aimed at improving health and safety, the risk of incurring a home injury remains high.

The design of the home environment can help to minimise the risk of injury or ill-health and this has been recognised in the development of building regulation and control in a number of countries. Despite this development, and a number of empirical research projects on environmental modification, injury in the home remains common. In 2002, 20\% of UK home accidents were associated with a construction feature within the home\cite{6}, the features involved included stairs, banisters, stair posts, walls, windows and door frames. Dwelling factors such as the design and condition of the dwelling, can contribute to an increased risk of injury and ill-health in the home, and human behaviour can affect the interaction with the
environment in two ways, either through different types of use or by changing the environment itself [7] [8]. A combination of behaviour and design can also contribute, but the interaction between the two has received little attention.

Heimplaetzer & Goossens [9] argue that whilst many ‘solutions’ to health and safety risks in the home have been translated directly into building codes or regulations these are interpreted by architects and designers as a guarantee that maximum safety is provided. However, building regulations here in the UK and elsewhere set only the minimum standards for the design of features associated with injury. Heimplaetzer & Goossens [9] also claim that many design features aimed at reducing the number of domestic accidents are chosen on the basis of partial or incomplete modelling of these solutions. For example in preventing children from falling down the stairs a closure may be fitted at the top of the stairs a closure may be fitted at the top of the stairs, but the consequences of this modification for an adult occupier is ignored. In this manner, safety measures introduced to protect occupiers from one hazard can introduce additional hazards within the home.

Previous studies have addressed specific design issues in relation to populations at risk, [10] but there is little research on the overall impact of construction features within the home and how these interact with occupier behaviour leading to increased risk.

The aim of this study was to gain an improved understanding of the ways in which people use their home and to identify how behaviour can interact with design to affect health and safety. In addition it aimed to establish the extent to which house designers believe their design meets long term user needs in relation to usability and maintenance and to establish the considerations given during design, to reducing the number of unintentional home injuries.

2. Method

2.1 Phase 1

Semi-structured, in-depth interviews and home audits were conducted with individuals recently inhabiting a new home. The interviews were fully transcribed and analysed using the qualitative software tool Nvivo. The analysis followed three steps; data reduction, data display, verification and conclusion drawing, as proposed by Miles and Huberman [11]. Validation of the coding was achieved by independent review of a sample of the data and subsequent interpretation by another researcher. The pattern coding provided the basis from which the conclusions within this study have been drawn.

2.2 Phase 2

Semi-structured, in-depth interviews were conducted with architects and designers involved in the house design process within the UK. An interview schedule was prepared which was based on the conclusions drawn from phase 1 of the research. These interviews were also fully transcribed and analysed using the software tool Nvivo following the three stage process for data management proposed by Miles and Huberman [11]. Validation of the coding was again achieved by independent review of a sample of the data and subsequent interpretation by another researcher. The pattern coding provided the basis from which the conclusions within this study have been drawn.

3. Results

3.1 Home interviews

The mean length of occupation of the properties visited during this study was 12.5 months (SD 8.6). The age of participants ranged from 20 years to 65 years (mean 37.5 years, SD 12.9). All participants were recruited on the basis of being the first occupiers of the property. Of the 40 properties visited, 4 were detached (separate dwellings), 3 were semi-detached (adjoined by one wall), 5 were terraced (adjoined by two walls), 20 were town houses (three storeys) and 8 were apartments/flats (one floor only).

A number of unsafe behaviours were reported by occupiers during interview. These behaviours arose as a direct result of the participant’s interaction with a building feature or system. Participants also reported a number of specific problems encountered whilst interacting with building features and systems within their home which they considered as hazardous.

3.2 Unsafe Behaviour

Among the 40 properties within this study, 26 were fitted with self-closing fire doors in line with current UK building regulations. In all 26 of these properties the owners/occupiers had interfered with the mechanism of the doors in some way. In 25 of the properties fire doors were wedged open and in 9 dwellings participants...
reported interfering with the self-closing mechanism itself. Some participants did show an awareness of the health and safety rationale behind the installation of fire doors, but reported a number of reasons for their behaviour. A full breakdown of these reasons is given in Table 1.

<table>
<thead>
<tr>
<th>Reason given</th>
<th>Number of households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise/Slamming</td>
<td>7</td>
</tr>
<tr>
<td>Inconvenience</td>
<td>7</td>
</tr>
<tr>
<td>Inadequate light</td>
<td>4</td>
</tr>
<tr>
<td>Prevent finger trapping</td>
<td>3</td>
</tr>
<tr>
<td>Personal strength</td>
<td>1</td>
</tr>
<tr>
<td>Unspecified</td>
<td>4</td>
</tr>
</tbody>
</table>

A number of unsafe behaviours were reported in accessing the loft/attic of the property. Of the 40 properties in this study, 32 had been built with a loft (roof void accessible via a hatch). A loft ladder had not been installed by any of the house builders and developers in any of the dwellings. In 5 dwellings, the occupiers had fitted a purpose-built extending loft ladder themselves, but in the remaining properties, access to the loft was achieved by various means including using general purpose ladders, stools, chairs, family members and furniture and fixings to climb on. A 33-year-old male described how he used his wife to stand on:

‘I've clambered up there using stools and using Tina to stand on, it’s quite bad’

The location of the loft access hatch also led to concern. The same participant described how he had fallen from the loft access hatch when the furniture he was standing on turned over:

‘sO I could have fallen down the stairs quite easily.
It's right next to the stairs.’

Unsafe behaviour was also reported in relation to DIY tasks undertaken within the home, particularly in relation to electrical safety and the water supply. The service cabling and piped was located behind plasterboard walls in all of the properties visited and 27% of households reported that they did not consider or seek to locate the routes of these services before drilling into the wall. A further 40% stated that they were unaware of the location of these services but did take care when drilling. A 27-year-old female described how she and her partner searched the walls for cabling and pipes:

‘we used to drill like really thin holes first to see if you can get all the way through and if you can you know it’s safe to get the big bit out and drill’

3.3 Building features and systems

Participants reported specific problems in relation to a number of design features and systems within their home which they identified as potentially hazardous. Scalding was reported in 2 cases resulting from high water temperatures, and a further 2 participants reported injuries sustained by descending stair newel posts, (newel posts are located at the top and bottom of a stair way and positioned at stair turns for structural support). A 37-year-old male described how he hit his head on the newel post when ascending the stairs:

‘and I whack my head on there…… because it’s quite sharp’

Emergency egress windows (a window provided for emergency egress purposes which should have an unobstructable openable area that is at least 0.33m² and at least 450mm high and 450mm wide), [12], was identified by some as introducing an additional risk for falls, particularly for children. An emergency egress window was fitted to windows on the first floor in 18 of the properties visited and in 13 of these the window was not fitted with a window lock.

Internal sloped ceilings are another feature which presented a risk of impact or head injury. These were found to be located above the stairs and also within bathrooms on the top floor of the three story properties. In 3 properties visited, occupiers complained of having struck their head due to these low ceilings. A 59-year-old female reported hitting her head on the sloped ceiling under the stairs:

‘and you are forever clouting your head’

Insufficient storage within the properties was also commented upon by participants as causing them problems. A 24-year-old mother of one explained about the lack of storage:

‘there’s very little storage, therefore you are leaving things lying around.’

This problem had led to occupier modification in a number of cases, whereby additional storage had been created via a number of different means.

3.4 Architect interviews

A number of factors were identified by architects as influencing their house design, these factors included government initiatives, such as density guidelines, consumer demand and planning issues. One
participant who had been involved in residential design for 6 years described the influence of the government density guidelines: ‘certainly we are forced more and more with these density guidelines to put more parking in communal parking areas.’

A number of competing factors were also identified, for example consumer demand was described as competing against the government density guidelines and the provision of safety features competes against security concerns. This was highlighted by one interviewee: ‘we’ve had the police giving advice on to how to design houses from the point of view of safety and access, criminal activities, so we start putting locks on all the windows, then the next legislations says you must be able to escape from this window and how can you escape when in the panic you have to find a tiny little aluminum key.’

The participating architects also highlighted a number of constraints that influence their design including the provision of social housing, local authority control and building regulations.

The architects interviewed during this study did not have access to recent data on home accident statistics. One participant, a sole practitioner explained: ‘if you asked me what the greatest, what the causes….., the most common accident in the home I couldn’t tell you.’

The responsibility for providing safe and efficient housing was clearly identified by some as lying with building control. By meeting building regulations, architects felt that they had achieved high levels of health and safety for the home. An architect within a private firm highlighted this: ‘I suppose…. that if you’ve met building regs, you know, unless someone wants to commit suicide, you know, even then they would have a job.’

One of the main considerations to the provision of effective safety features was described as being cost. This was a barrier for some of those interviewed. One example was given by an architect who had been involved in residential design on behalf of a major house builder for a number of years where cost prevented the provision of loft ladders within the properties: ‘again you don’t need to do it, you know, it’s done on cost isn’t it.’

Those architects working in private practice however were more sympathetic to the provision of this item, and those designing bespoke properties tended to include a loft ladder as standard within their designs.

The provision of alternative fire protection was also viewed as costly by some architects: ‘I think it could be feasible, but again it’s cost though as well. It’s cheaper just to have maybe door closers’.

In terms of preventing unintentional injury arising through the interaction between behaviour and design, architects felt that they were limited in what they could do. Responsibility for health and safety within the home was clearly placed with the occupiers themselves. An employee of a private company summed this up: ‘I mean the reasons for why accidents happen in the home is down purely to the person you know…… you can walk through a door and bang your head on the frame, but it’s not because the frame is in the wrong place, it’s because you are stupid enough to walk into it’

4. Discussion

This study has identified a number of unsafe behaviours arising as a direct result of the occupant’s interaction with the building features and systems of their home. The study also identified a number of problems that are experienced with specific construction features and systems. These problems may lead to a risk of injury in two ways; as a result of interacting with the feature or through inadequate occupier modification.

Despite there being prescribed safety requirements in force in relation to the design and construction of new homes within the United Kingdom, these results suggest that the interaction between human and dwelling factors leaves a continuing risk of injury in current house design. The findings support the claim that both behaviour and dwelling design are important contributory causes in unintentional home injuries [2]. Within this study, structural features have been shown to present specific physical hazards and particular behaviours have been reported which, as a result of an interaction with a feature, introduce additional risk.

From these results, it is evident that there may be scope for improved interventions to enhance home safety. The behaviours reported in this study may be amenable to prevention through alternative design. The increased risk of falls, for example, in accessing the loft space, could be prevented by a requirement for the provision of loft access ladders in all new build homes. Improvements to dwelling design such as this can be
incorporated in all new dwellings through building control regulation. A number of the problems reported by occupiers during this study may also be preventable. The re-design of stair newel posts and sloped internal ceilings would reduce the risk of unintentional head injury, and the provision of storage might lessen the amount of clutter and reduce the potential for slips, trips and falls.

It is striking that in each of the homes fitted with self-closing fire doors, the occupiers had interfered with the fire door mechanism in some way thereby significantly reducing the level of protection afforded through their installation. This highlights why engineered fire protection in the home needs to consider human behaviour from the outset if it is going to afford protection to the occupants. In addition to this, improved design of the self-closing mechanism itself might be a means for eliminating the hazard of finger trapping injuries. It is important to consider from the outset any risks that may be introduced by the safety measures themselves. The installation of self-closing fire doors within dwellings is an example of the partial or incomplete modelling of a solution [9] whereby the consequences of the modification for occupants has been ignored.

Previous initiatives for improving home safety have focused on the human factors which may contribute to domestic accidents, or the design of the home environment itself. This study has demonstrated that the interaction between human factors and dwelling design itself should be considered in the design of new homes in order to reduce the risk of injury of ill-health.

The results from the interviews with professionals are illuminating and show that architects and designers do rely heavily on building regulations to ensure the provision of safe housing, as suggested by Heimplaetzer and Goossens [9]. Whilst building regulations do go some way in affording protection in the home, additional safety considerations may be possible during the architectural process to design unsafe features out of our new homes.

The lack of information available to architects concerning the nature and extent of home injuries in the UK is a cause for concern and suggests that there is a need for clearer lines of communication from research findings to those in commercial practice. The diverse nature of health and safety risks within the home suggests a mixed and multi-disciplinary approach to prevention may be of value.

The findings from this study should be of interest to those responsible for the development of building standards, procedures and guidelines, informing them of the impact of occupier behaviour on current safety standards. Alternative design of a number of features within the home may improve health and safety and reduce the potential for unintentional injury.

References