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Developing an audit checklist to assess outdoor falls risk

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Falls by older people (aged 65+ years) are linked to disability and a decrease in mobility, presenting a challenge to active ageing. As such, older fallers represent a vulnerable road user group. Despite this, there is little research into the causes and prevention of outdoor falls. This paper develops an understanding of environmental factors that cause falls or fear of falling by using go-along interviews with recent fallers to explore how they navigate the outdoor environment, and which aspects of it they perceive facilitate or hinder their ability to go outdoors and fear of falling. While there are a number of audit checklists that are focused on assessing the indoor environment for risk or fear of falls, nothing exists for the outdoor environment. Many existing street audit tools are focused on general environmental qualities and have not been designed with an older population in mind. This paper presents a checklist that assesses aspects of the environment that are most likely to encourage or hinder those who are at risk of falling outdoors, it is developed through accounting for the experiences and navigational strategies of elderly individuals. The audit checklist can assist occupational therapists, urban planners, designers and managers in working to reduce the occurrence of outdoor falls among this vulnerable user group.

1. Background

Active ageing remains on the policy agenda, encouraging an ageing population to remain active outdoors and maintain independence for their health and well-being. However, older adults who are at risk of falling over outdoors are a vulnerable user group in the urban environment. Falls are the leading cause of hospitalisation in people aged 65 years and over and of accidental death among those aged 75 years and over. Falls present a risk and a threat to the mobility of an ageing population, with 30% of those aged 65 years and over falling each year (Skelton and Todd, 2004), and present a considerable burden to the healthcare system, accounting for ~10% of ambulance calls (Skelton and Todd, 2004). Although only around 5% of falls result in fracture, the consequences are serious, with approximately half of those who experience a fracture never being a functional walker again and 20% dying within 6 months. Furthermore, a larger proportion experience soft tissue damage, which may also significantly impact on function, and those who repeatedly fall may experience depression, loss of self-confidence, fear of falling, social withdrawal and loneliness (Skelton and Todd, 2004).

Therefore, there is evidence to suggest that falling poses a more general threat to the overall quality of life for an older population. First, injury as a result of falling may limit mobility and makes it more difficult for people to get outdoors, leading to further decline in their physical and mental well-being. Second, it has been suggested that fear of falling affects quality of life (Perez-Jara *et al.*, 2010) as many people are unhappy being 'stuck' indoors but do not leave the house due to fear of falling over (Hjorthol, 2013). It is therefore clear that reducing both incidences of falls and fear of falling is important.

Research exploring the relationship between neighbourhood design and walking in the outdoors is a well-established and growing area (Brownson *et al.*, 2009; Sallis, 2009). Although historically walkability studies have not focused on specific populations such as older people (Michael *et al.*, 2006), some more recent studies have addressed this (Grant *et al.*, 2010; Van Cauwenberg *et al.*, 2012; Vine *et al.*, 2012; Ward Thompson *et al.*, 2014). Michael *et al.* (2006) found that the main factors influencing walking for an older population were local shopping facilities, concerns about traffic, inadequate pedestrian infrastructure, sense of attractiveness and public transport availability. Grant *et al.* (2010) reported the biggest barriers to walking to be hostile environments, particularly road crossings and Nordbakke (2013) cites the most common

barriers to walking to be built-up infrastructure (such as steps and kerbs), anxiety in crowded environments, fear of traffic, potential for accidents and fear of crime.

Older fallers represent a subset of the population who are likely to perceive the environment differently, and environmental barriers may both be a direct cause of a fall and exclude those who fear falling from using certain spaces, yet little is known about which features of the 'outdoor' environment present a risk factor for falling (Nyman *et al*., 2013). Issues of balance, eyesight and physical ability mean that an older population, particularly those who have fallen, may have a specific experience of the outdoor environment that is not accounted for by existing street audit tools and checklists. A greater understanding of features of the outdoor environment that contribute to falls would allow those responsible for the design, management and maintenance of municipal environments to contribute to both reducing the occurrence of falls and encouraging outdoor activity by enabling those who fear falling to use outdoor space with greater confidence.

Outdoor falls have been called a neglected public health problem, occurring at least as often as indoor falls (Li *et al*., 2006). According to Li *et al*. (2006), up to three-quarters of falls are precipitated by poor environmental conditions, mainly tripping and slipping on uneven or wet surfaces. On the basis of focus group research, Nyman *et al*. (2013) classify environmental causes of falls into tripping hazards, uneven or poorly maintained pavements, dogs (pulling or running in front of a person), weather and loud noises. Using a spatial approach to identify where outdoor falls occur Lai *et al*. (2009) found junctions, wet surfaces, crowds, and uneven and mixed surfaces in areas where there was a large concentration of falls.

A number of audit tools designed to assess the walkability of the outdoor environment already exist (Leslie *et al*., 2007; Millington *et al*., 2009; Pikora *et al*., 2002) and some are specific to an older population (Cunningham *et al*., 2005; Michael *et al*., 2009), but none specifically address features of the environment that are likely to cause problems for those at risk of falling. There have been calls for public health professionals to consider outdoor as well as indoor falls (Nyman *et al*., 2013) in order to develop tailored fall prevention plans (Scott *et al*., 2003), but at present there is limited evidence of the environmental causes of outdoor falls and therefore practitioners find it hard to advise older people on outdoor risk factors.

In contrast, there is a large body of research into the causes of indoor falls. Furthermore, there are existing audit tools and checklists designed to assess the indoor environment for risk of falls, but there are no audit checklists assessing the outdoor environment specifically for falls risk. Studies of falls risk factors tend to focus on the individual and their functional limitations (Yamashita *et al*., 2012). Fear of falling inside the home is usually assessed using a scale such as the Falls Efficacy Scale International (FES-I) (Yardley *et al*., 2005), which assesses people's fear of falling in relation to undertaking the following typical day-to-day activities: cleaning the house, getting dressed/undressed, preparing simple meals, taking a bath or shower, going to the shop, getting in or out of a chair, going up or down stairs, walking around outside, reaching up or bending down, answering the telephone, walking on a slippery surface, visiting a friend/relative, going to a crowded place, walking on an uneven surface, walking up or down a slope, and going out to a social event. Given that outdoor fallers tend to be younger and more active (Bath and Morgan, 1999; Li *et al*., 2006), these items may be inadequate for assessing outdoor falls. Hill *et al*. (1996) added four outdoor items to the FES-I: using public transport, crossing the road, light gardening or hanging out washing, and using the front or rear steps at or near home. While these scales assess the fear of falling for an individual based on their capabilities, it provides a limited understanding of environmental features that may enable or deter them from doing such activities outdoors. Furthermore, while risk factors for indoor falls are usually health based (Bath and Morgan, 1999), the environment may play a greater role in outdoor contexts. Connell and Wolf (1997), and Iwarsson *et al*. (2009) have focused on the interaction of the environment and the individual for indoor falls; such an approach may be particularly relevant for outdoor falls.

The concept of environmental support, focusing on environmental quality in relation to desired activities, is central to the approach in this paper. Lawton and Nahemow (1973) developed an ecological model of ageing that introduced the concept of environmental press – the differential effect of the environment on behaviour that relates to the capabilities and characteristics of the individual. Building on this and the transactional relationship between people and place, models of environmental fit (Carp and Carp, 1984; Kahana, 1982; Lawton, 1980) have been developed to describe how the environment can become a limiting factor on people's mobility as their functional capabilities change in old age (Iwarsson, 2005). Related to this, the concept of environmental support draws on the work of Kelly (1955), and Little (1983) to focus on environmental quality in relation to desired activities, especially for an ageing population. Environmental supportiveness is seen as the extent to which the environment supports or hinders physical activity (Sugiyama and Ward Thompson, 2007a, 2007b). As a concept, it links environmental attributes with people's perceptions of them in relation to their own idiosyncratic, desired and necessary activities. The aim of this study was to develop a checklist that assesses aspects of the environment most likely to encourage or hinder those who are

at a risk of falling outdoors through a focus on person–environment fit. Iwarsson *et al.* (2009) found that using a person–environment fit approach led to a better prediction of indoor falls than focusing solely on environmental factors.

Although people of all ages may fall over as a result of a poorly maintained or designed environment, older adults are a vulnerable user group due to the heightened risk, both of falling in the first instance and of subsequent injury. Furthermore, the psychological effects of falling over may inhibit outdoor activity and mobility of older people, given that fear of falling is associated with going outdoors less often and the biggest causal factor for fear of falling is having experienced a prior fall (Scheffer *et al.*, 2008). An understanding of the environmental causes of falls in an ageing population is therefore vital for inclusive design, planning and management of the urban environment, with the potential to improve quality of life for this growing demographic.

On the basis of this, drawing together the fields of public health and urban design, this paper develops an audit checklist designed to assess the outdoor environment for falls risk, by identifying features that may cause falls or fear of falling, and drawing on the experiences of older adults who have fallen. The approach for developing the audit checklist is presented in the methodology section. The results section consists of the identification of aspects of the environment likely to cause falls or fear of falling, followed by the checklist itself, and finally the discussion section presents potential uses and limitations, given that reducing the risk of falling and encouraging older people to remain active outdoors is important to both public health and urban environment professionals.

2. Methods

This section describes the approach taken for developing an audit checklist. Checklist development followed a three-stage process, as shown in Figure 1. First, based on a review of existing street audit tools and a review of the falls literature, summarised above, a draft checklist was produced consisting of environmental features that it was anticipated might present a problem to an older population in general and specifically those who had fallen, or are at risk of falling, outdoors. 'Older people' are defined as those aged 65 years or older. The Scottish Walkability Assessment Tool (Millington *et al.*, 2009) was used as a starting point for the audit checklist. Tools such as this collect detailed environmental information, which was useful to ensure anything potentially relevant in the UK context was considered. However, the aim was to build a checklist drawing on the experiences of those who had fallen, rather than external auditors, and therefore the method sought to move beyond this long and detailed checklist to a more parsimonious list that was nonetheless relevant to older people's experience and relevant to those charged with falls risk assessment.

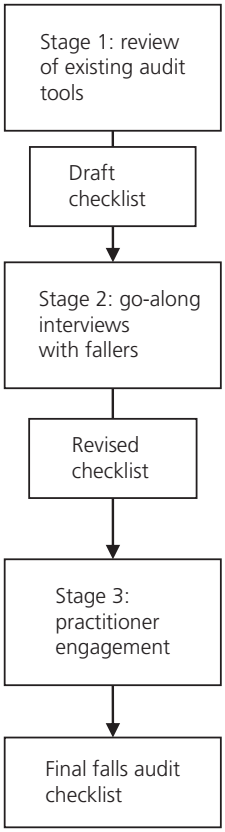

Figure 1. Development of audit checklist

2.1 'Go-along' walking interviews

Accompanied walks were undertaken with 20 older adults (aged 65 years and over) who had experienced a fall in the previous 12 months. The 'go-along' method was used, combining ethnographic participant observation with interviewing (Carpiano, 2009), to gain the perspectives of older people who have fallen over on their experiences of the outdoor environment. This approach is particularly suited to environmental perception (Kusenbach, 2003).

The study used a convenience sample, recruited from those who had already participated in a focus group about falling outdoors (Nyman *et al.*, 2013), and were recruited based on having experienced a fall during the previous year and their willingness to participate in further research.

Although some participants had experienced fractures and bruising, the majority of participants had not sustained long-term physical injuries from their fall, but many were affected emotionally. There are limitations to interviewing using such a convenience sample and there is a potential bias from interviewing only those still able to walk about, although in some

cases using a walker or rollater. However, given the emphasis on the environment, rather than trying to understand all impacts of the fall, the sample was by necessity still relatively mobile. Participants were selected across a spectrum of geographical areas, functional status, gender and age groups. Demographic characteristics of the participants are included in the results section. The study was limited to a 12-month period, with only one opportunity for undertaking interviews. The interviews took place in Autumn 2012 across four UK cities: London, Edinburgh, Salford and Swansea. Temperatures were mild (10–15°C) and some light rainfall was experienced.

Seventeen women and three men were interviewed with a mean age of 77 years (standard deviation (sd) = 6·71). It was challenging to recruit men to the study as has been previously discussed (Nyman *et al.*, 2013); this is a limitation of the study. Functional status was assessed using the Instrumental Activities of Daily Living Scale (IADL) based on Jette *et al.* (1986). Respondents rated the level of difficulty (1–5) experienced undertaking the following activities: seeing for reading, seeing for getting around, hearing, remembering things, getting around, and to rate how hard (1–5) they find it to: walk 500 yards, climb stairs, do housework, do errands, use public transport and do physical activity. IADL scores ranged from 1 to 3·45 (out of a possible 5) with 1 representing the highest level of function and the mean score across items being 1·86 (sd = 0·79).

To help determine the route of the walk, participants completed a short questionnaire before the walk to collect demographic data and information about their day-to-day activities using a personal projects approach (Little, 1983; Wallenius, 1999). Personal projects are used to elicit the kind of outdoor activities participants undertake and were used to determine the route of the walk by walking to one of the places listed in the personal projects section, following the methodology of Van Cauwenberg *et al.* (2012) who used pre-information on participants' daily activities to help decide the route. An alternative option would have been to walk participants on the same route to understand how different individuals assess the same route, which would have resulted in a detailed audit of a particular environment, reflecting the variation among participants' perceptions as well as validating items within a controlled environment. However, interest lay more in taking participants on a walk familiar to them and understanding the environmental features that they perceive to be beneficial or deterring in a familiar and comfortable environment. Given that unfamiliar environments result in an increased falls risk (Phillips *et al.*, 2013), and all of the participants had previously fallen, it was deemed preferable to undertake the research in familiar environments. Nonetheless, to reduce undue stress on participants, a pre-determined route was prepared in case they could not easily decide on a route but, in the event, this was not required by any of the participants. Photographs were taken during the walks as appropriate to show areas participants highlighted as particularly positive or negative. The interviews were audio and global positioning system (GPS) recorded and transcribed verbatim. The mean walk length (measured using GPS tracking) was 0·82 miles (sd = 0·45), taking 25·1 min (sd = 10·92).

2.2 Development of audit checklist

As outlined above, the development of the checklist was undertaken in a number of stages, drawing on the results of go-along interviews to determine items for inclusion in the audit checklist. Analysis of the accompanied walks was undertaken in two stages. First, transcripts were scanned and a matrix of interviewees' comments against factors that were identified in the draft audit checklist was completed. During this stage, additional environmental factors mentioned by interviewees were added to the matrix. This was completed twice, first for factors that had caused a fall, and second those that were identified as potentially problematic or causing a fear of falling among participants. The factors identified both in the draft checklist and initial scan of interview transcripts were then used to create a coding framework. Interview transcripts were subsequently coded by the researcher in more depth according to this framework before revisiting the spreadsheet matrix to highlight the environmental features identified as positive or negative by each of the participants. Following this, the draft checklist was revisited to ensure that those things mentioned most by interview participants were included. Those that featured most prominently were then retained to create a parsimonious checklist that reflected aspects of the environment most likely to contribute to falling, or fear of falling.

The final stage in the development of the checklist was a workshop held with healthcare practitioners that are usually involved in assessing the home for falls risks. Practitioners were mainly National Health Service healthcare workers or local authority falls practitioners and were recruited through Age UK, an older people's charity that run a range of similar events for professionals. The revised checklist was discussed with them to establish how it could be improved to make it useful and straightforward to use for practitioners. The workshop was used first to discuss in more depth some of the environmental factors causing falls and fear of falling, using photographs taken during the accompanied walks as a guide. Second, the checklist was discussed in terms of the items included and, crucially, how falls practitioners would envisage using such a checklist and how it might be useful to them.

3. Results

Results are presented in three stages. First, environmental barriers for older fallers, identified from the interviews, are presented. The second stage presents the results from

engagement with healthcare practitioners. Finally, the audit checklist is presented.

3.1 Environmental barriers for older fallers

In this section, the environmental features included in the checklist are described. These were derived using the process described in the methods section (Figure 1). Each of the environmental barriers that influences falling or fear of falling is discussed.

3.1.1 Changes in level

Changes in level stand out as the one most significant environmental feature affecting the experiences of those who have fallen, and are perceived to have caused falls. These could take the form of kerbs, slopes or steps, or more unexpected changes in levels such as uneven paving. Almost all of the participants felt that they had fallen due to tripping over uneven ground. Further to this, they now saw changes in levels as problematic and this had led to a heightened level of concentration required whenever they are walking. Changes in levels may be substantial, for example, steps or kerbs, or less substantial, such as uneven paving, drains or manhole covers. Figures 2–4 show some examples of changes in levels, which were highlighted by the participants. It was noted that the tolerance level for uneven flags of up to 25 mm vertical difference is not suitable for older people, who have more problems with balance and are unable to lift their feet as far from the ground, meaning that even the smallest of changes in level as a result of uneven paving flags can present a hazard.

As shown in Figure 4, changes in levels may be sudden or more gradual. Slopes, as well as steps, present a problem. It must be noted, however, that each individual usually had a preference for one over the other, depending on individual capabilities. It is therefore difficult to suggest that either ramps or steps are preferable to those at risk of falling, but rather that an inclusive environment would include both options for changing levels.

Figure 2. Changes in levels – drain across pavement

Figure 3. Changes in levels due to manhole covers

Figure 4. Changes in levels – steps and slopes

Tapered steps such as those in Figure 5 present a particular challenge due to the variable rise in height along the length, which may be especially difficult for those with poor eyesight.

3.1.2 Path condition and smoothness

The condition and smoothness of paths were mentioned by almost all participants. This is related to changes in levels as previously discussed. Poorly maintained pavements cause trip hazards as a result of changes in levels. Older adults are likely to experience changes in gait affected partly by a decreased range of ankle motion (Spink *et al.*, 2011), affecting their ability to navigate uneven pavements. Further to this, those who have fallen and those who are struggling with balance are likely to lift feet less high above the ground, meaning that uneven pavements that might easily be navigated by a more mobile person present a threat to those at risk of falling. Figures 6 and 7 show examples of varying path conditions, all of which present a threat.

Figure 5. Changes in levels – tapered steps require greater concentration and are a source of stress

3.1.3 Path material

The majority of participants referred to the surface material of paving as being influential in how they perceived the environment. Setts (cobbles) and flags (paving stones) were problematic for many because they are more likely to be uneven and setts, in particular, are likely to be slippery. Of particular note is tactile paving, designed to denote the presence of a crossing point for those with poor eyesight or visual impairment, but which, for those who are unsteady on their feet, can be both uncomfortable and cause imbalance (Figure 9). Most of the participants mentioned blacktop/bitumen as favourable for being slip resistant and less likely to be uneven (Figure 8), although this is not always the case, as seen from Figure 7.

3.1.4 Obstructions

Obstructions along a route can cause loss of balance, create uncertainty or cause detours that may result in falling. Obstructions may be permanent, such as fixed rubbish bins and benches, or temporary such as vehicles, dustbins, litter or billboards (Figures 10–12). Obstructions present various kinds of hazard. Examples from the interviews include a slip hazard caused by vegetable peeling, having to manoeuvre around

Figure 6. Cracked paving flag and wet conditions

Figure 7. Bitumen surface made uneven by tree roots

Figure 8. Most partcipants said bitumen was the most comfortable surface to walk on

Figure 9. Tactile paving and setts are uncomfortable and can lead to imbalance

Figure 10. Temporary obstruction – parked vehicles

Figure 11. Multiple temporary obstructions – litter, scaffolding and parked bicycle

Figure 12. Temporary obstruction causing change of route and change in levels

vehicles or dustbins or feeling uneasy due to streets crowded with people. This highlights how obstructions can be dynamic and that the social environment is also an important factor in assessing falls risks, as has previously been highlighted (Nordbakke, 2013).

3.1.5 Road crossing

Rushing and lack of concentration were often cited as reasons for the cause of a fall, meaning that the type of road crossing can be important for how fallers perceive the environment. Crossing the road requires additional concentration and often involves rushing to cross during the pedestrian phase, which is frequently not long enough for older people (IDGO, 2013). Other research (Hill *et al.*, 1996; Lai *et al.*, 2009; Nyman *et al.*, 2013) has identified traffic, or fear of traffic, to be a major risk factor for falls, although this was not frequently mentioned by the participants as busy roads were avoided where possible so were not necessarily encountered on go-along interview walks.

3.1.6 Street lighting

It was not anticipated that street lighting would be directly related to falling, but it was found that the available light could cause distractions and therefore reduce the level of

concentration. One participant talked about how shadows were distracting and she could not tell whether there was a shadow or a step, making it hard to negotiate the environment or anticipate obstacles. Related to this, eyesight was mentioned by a number of participants as affecting their ability to get about with confidence. Environments sensitive to those with visual impairment are therefore important in reducing falls risk.

3.1.7 Weather

The weather is a dynamic factor, having a significant impact on falls and falls risk. As shown by Figures 13 and 14, if the street environment is not designed or maintained well, then during certain weather conditions falls risk can be enhanced, as certain surfaces will become slippery and people may have to detour. Icy conditions, in particular, are likely to lead to an increased falls risk. Windy conditions can also cause imbalance problems for older people. Urban environments should be designed to ensure that wind tunnels are not created by tall buildings, taking into account the direction of prevailing winds.

So far, the main environmental attributes that were highlighted by the participants as having resulted in falls and leading to a fear of falling have been reviewed. However, these are rarely a problem in isolation; rather, multiple factors frequently interact to cause falls or fear of falling. Figure 15, for example, shows an example where path material (tactile paving), slope and poor maintenance (leaves and moss) combine to create a difficult environment.

3.2 Engagement with healthcare practitioners

During the workshop with falls practitioners there was general agreement that items included in the checklist that was presented were sufficient to be useful and reasonably comprehensive, although a few suggestions were made. In general, the idea of a checklist similar to those currently used inside the home was welcomed, although it was stressed that falls practitioners would need training and guidance on how to use the checklist and what follow-up actions could be taken. There was a general consensus that the outdoor environment is not considered as much as the indoor environment by falls

Figure 13. Accumulation of water during wet weather conditions may increase slip risk

Figure 14. Uneven pavement and accumulation of water makes this road crossing challenging

Figure 15. Multiple hazards – slope, tactile paving surface, moss and road crossing

practitioners but that it is an important aspect that deserves more attention.

A number of improvements were made to the proposed audit checklist following engagement with practitioners. The 'path material' section was changed to include non-technical language, for example, 'cobbles' instead of 'setts', as health practitioners are unlikely to be familiar with the technical terms. Following the workshop, space was added for notes, so that where a problem exists it can be highlighted or more relevant details provided.

In the discussions, both with older participants and professionals, it was highlighted that dynamic factors such as the weather are important but difficult to include in the audit as they are so variable. However, weather has been included in the audit checklist as some of the environmental features will be more of a hazard during particular weather conditions. Recording the weather therefore acts as a reminder that the audit was undertaken under particular conditions and can remind auditors to consider what the situation would be under differing weather conditions.

Some of the practitioners said that they already, informally, assess the outdoor environment on a case-by-case basis and echoed the conclusion that there cannot be a 'one-size-fits-all' approach to what affects each individual's access outdoors. However, it was recognised that a checklist could be a useful starting point, especially for training new occupational therapists if there were moves towards assessing the outdoor environment as a standard practice. Practitioners also informed us that, in some areas, they do outdoor walking practice with those who have fallen and they suggested that the checklist would be very useful to assist them with this and highlight the key things of which to be aware. Those who did not currently assess the outdoor environment said they would take these findings back to colleagues and suggest incorporating outdoor audits.

The importance of ensuring that action is taken where problems are identified was emphasised. Some felt that, in the case of problems with public provision such as pavements or footways, if they knew the council website and there was an easy form to complete to register a problem, then it would not be too difficult for them to report issues such as uneven pavements, but others felt this was beyond their remit. This led us to include the recommendation to report issues using 'FixMyStreet' (FixMyStreet, 2015), which does not require searching through individual council websites but sends reports relating to poor pavements and so on, direct to the relevant council. This clearly only serves a UK context but is particularly important as UK health board areas do not match council areas, so an occupational therapist may be working across several local authorities and not always know which one is appropriate to approach for any given patient.

3.3 Audit checklist for assessing outdoor falls risk

In this section, the audit checklist is presented (Figure 16) and designed to be used by occupational therapists and other professionals working with older people at risk of falling in order to help them navigate the urban environment, as well as urban designers and planners creating outdoor places, and those responsible for managing and maintaining municipal services.

Advice from the falls practitioners was to create a short, two-sided checklist that was easy to use and not weighed down with the minutiae of detailed guidance so as to become unworkable.

When considering the use of the checklist by occupational therapists, following the fieldwork experience with participants, environmental awareness was high following a fall. Older people themselves may be best at knowing what they should avoid and strategies to avoid falling again; however, for those who have fallen, a walk and a chance to discuss issues with a qualified professional is likely to give them renewed confidence. Additionally, for a person who is at risk of falling (due to health conditions), the audit checklist would be useful to identify potential barriers and strategies for going outside.

Beyond this, the audit checklist offers those responsible for the urban realm an aid to ensuring that environments are designed with older people and falls prevention in mind.

Figure 16 shows the revised audit checklist following accompanied walks and discussion with falls practitioners. The guidance sheet giving information on how to complete the checklist is provided in the Appendix.

4. Discussion and conclusions

Falling and the fear of falling threaten the ability to get outdoors and maintain quality of life for older adults. The audit checklist serves a number of purposes. For those who have fallen in the past the audit checklist is designed to be used to build a picture of an individual's environment, to identify risk factors and to help decide the best way to prevent or minimise future falls. It also offers opportunities to prevent falls for older people moving into new and unfamiliar environments. For those who fear falling being able to go on a walk with a qualified professional and audit their local environment may give them the confidence and familiarity to remain active outdoors. This may be particularly useful at the point when people move house, perhaps into assisted accommodation in an unfamiliar area. Recent research (Phillips *et al.*, 2013) has highlighted the heightened cognitive load associated with being in unfamiliar

Assessment of the local Outdoor Environment for falling over

This assessment tool has been developed based on research undertaken with olderpeople who have fallen to understand aspects of the outdoor environment which have caused them to fall or fear falling.

It is designed as a starting point for assessing potential risks near to the homes. Assessments should be undertaken on a case by case basis.

Date:			
Assessor			
	✓	***Notes (e.g. location)***	***Recommendations***
Weather			
Wet			
Windy			
Icy			
Type of path			
Pavement			
No path			
Path forms useful and direct route			
Path is disjointed			
Slope			
Mostly level			
Slight gradient			
Steep (difficult to walk)			
Path condition and smoothness			
Poor (a lot of bumps, cracks, holes, weeds)			
Moderate (some of the above)			
Good (very few of the above)			
Under repair			
Path material			
Tarmac / black surfacing			
Paving blocks (small)			
Paving slabs (large)			
Tactile Paving			
Setts (Cobbles)			
Hoggin (Smooth but not paved)			
Loose gravel			
Mud / earth / unpaved			
Grass			
Usable width of pavement			
Suitable for only 1 person			
Suitable for 2 people			
Suitable for > 2 people			
Permanent path obstructions			
Poles			
Signs			
Table & chairs			
Utilities covers/manhole cover			
Overhanging Trees			

Figure 16. Proposed audit checklist (continued on next page)

Tree roots			
Steps			
Height of step			
Number of steps			
Handrail			
Depth of step (consistent?)			
Road Crossing			
Kerb Height			
Able to cross directly using dropped crossing points			
Road width (lanes)			
Controlled by lights			
Temporary Obstructions			
Leaves			
Sitting water/Puddles			
Dustbins			
Litter			
Scaffolding/Construction			
Other			
Street Lighting			
Streetlights present			
Path is well lit			
Social Environment *(e.g. crowded streets)*			

Guidance Notes (see attached guidance for more detail):

Where appropriate advise on alternative routes or means of adapting (eg footwear, walking aids)
If a problem needs reporting to the council note the location and report using www.fixmystreet.co.uk

Figure 16. Continued

environments. Using the checklist may therefore assist in developing familiarity, with a specific focus on environmental attributes that contribute to falling and fear of falling.

Trips, slips and loss of balance are the main causes of falls (Bath and Morgan, 1999; Scheffer *et al.*, 2008) and there are several aspects of the environment that make these more likely. As identified, this includes changes in levels, path material and condition, types of road crossing, and street lighting. The weather is also important and, while designers do not have control over this, the urban environment should be designed with weather conditions in mind so as not to create slip hazards due to accumulated water or wind tunnels, which may lead to loss of balance. Tall buildings, in particular, an increasing feature of inner urban areas, can lead to wind turbulence and funnelling, and add to the challenge of negotiating outdoor environments. During the interviews, participants often talked about the level of concentration required to navigate the environment, even a familiar one. Environments therefore need to be not too complex to navigate in order to reduce cognitive load and reduce the likelihood of falling due to an inability to concentrate.

Given the dearth of research into the causes of outdoor falls, this makes a useful contribution by highlighting the most pertinent environmental features that may lead to falls or fear of falling. The audit tool is also relevant, therefore, to those responsible for providing and managing municipal services and, in particular, the public realm of outdoor streets and spaces. The key points highlighted as problematic for older fallers should be considered at the design stage, thus reducing the need to mitigate risk further down the line. However, the features identified may also allow planners and managers to prioritise remedial work to the environment and ensure that quality of materials and levels of maintenance are appropriate.

There are several limitations inherent in the use of any such checklist, not least that there cannot be a tool that will give due weight to all aspects of the environment as they are perceived by each individual. In this vein, the checklist is not designed to be an assessment of the environment per se, but to be used by occupational therapists, alongside individuals at risk of falling, in order to highlight areas where falls risk may occur and, where appropriate, report poorly maintained or poorly designed streets to the relevant body. While the audit

checklist may not contain any surprises in terms of the environmental features included, it is useful as a starting point for those with little awareness of what may contribute to outdoor falls, given the limited research in this field to date.

Assessing the outdoor environment for falls risk focuses on more micro-environmental assessment than a walkability measure, for example, which may also consider proximity of destinations. This aspect of a walkable environment has not been considered in developing the checklist. However, neighbourhood walkability is also of potential importance for falls at a different scale, as shorter distances may reduce the likelihood of falling over; however, it was not highlighted as an immediate concern among participants.

The analysis presented here relates purely to the identification of environmental features for the development of an audit checklist. However, an analysis of the go-along interviews shows that participants' relationship with the environment is complex and the intention is to publish a subsequent paper exploring the experiences of older fallers in more depth. Participants often discussed the decisions they made in determining which way to go or how to negotiate a certain environment, for example, choosing a steeper route with fewer fallen leaves, or a longer way around to avoid steps, or a busy road. This highlights the potential for future research to use techniques such as choice-based conjoint analysis to further understand the factors influencing fear of falling in an older population.

It is difficult to encapsulate the variety of experiences and numerous ways in which older fallers experience and relate to the environment in an audit checklist, which is by nature reductionist. The audit checklist therefore highlights the main environmental attributes most likely to hinder or support this particular user group. However, as outlined in the introduction, this approach based on person–environment fit recognises that individuals interact with and perceive the environment differentially, so identification of features presenting a falls risk may often be contradictory, meaning it is difficult to make design recommendations. However, taking the results presented here can help urban designers and planners ensure that the environment is designed and managed in an inclusive manner by offering options to those with different needs and preferences.

Audit checklists, in general, can be criticised for not being explicit on how the data are subsequently used to inform practice. By contrast, this checklist was designed with a practical purpose in mind, not to collect detailed data about the environment, but as a guide for occupational therapists and built environment professionals. Future research should seek to develop a validated tool for measurement by taking the checklist items and checking inter-rater and intra-rater reliability for specific street segments and by undertaking a quantitative analysis of the environmental features identified for predicting outdoor falls.

5. Practical relevance and potential applications of the checklist for urban planners, designers and managers, and for occupational therapists

This checklist provides two differing functions within the same document. For built environment professionals, including urban designers and planners, as well as highways and civil engineers, landscape architects, municipal authorities and city centre managers, it forms an *aide memoire* of the elements that are critical within the outdoor environment to minimise the risk of falls by older people. Using this checklist it is possible to focus on what in the environment are likely to be the major concerns of those with a fear of falling, and to then look for better practice solutions. For occupational therapists, it provides support for a process to go beyond the garden gate of an individual and explore the outdoor goals a person might have, and then use the checklist to identify routes that avoid potential hazards. Importantly, the elements identified are evidenced by way of a research process that ensures they reflect the real concerns of those who have fallen and now have a fear of falling.

Falls practitioners and occupational therapists engaged in the research process were enthusiastic about a checklist that was easy to understand and use. However, how best to feed information on environmental problems noted from using the checklist back to those with a potential to resolve the issues remain a work in progress. Other parts of this research project have been investigating a 'Stop that Fall' website that would enable information from the checklist to be directed to the relevant places and professionals, to try to prevent further falls in a manner that moves away from insurance claims drivers towards more positive ways to improve the outdoor landscape. What has become apparent from this research on the outdoor, urban environment is that there is a need to join up the contribution of disparate professionals – falls practitioners and occupational therapists with urban designers and civil engineers, for example – to find ways to flag up potential fall hazards and rectify them expediently.

Appendix

A1. Guidance notes: assessment of the local outdoor environment

This assessment tool has been developed based on research undertaken with older people who have fallen to understand aspects of the outdoor environment, which have caused them to fall or fear falling.

It is designed as a starting point for assessing potential risks close to the home. Assessments should be undertaken on a case-by-case basis.

This sheet provides guidance on using the tool to assess the outdoor environment.

A1.1 General guidance

The audit is designed to be undertaken during or following a short walk around the local area to help a person who has fallen to regain confidence in the outdoor environment and highlight any areas of concern. Some aspects of the street environment are likely to be a problem and could be pointed out to the individual. However, it is also likely that they have strategies for negotiating their environment so this may not be an issue for every individual.

Use the notes section to detail where the issue is, for example, a specific section of route or generic problem. This will help in reporting the issue afterwards.

There is a column for noting down how any issue will be addressed. This will either be advice to the individual on how to manage or avoid difficult areas, or reporting an issue to the authority responsible. The website FixMyStreet (2015) is useful for reporting a problem to the correct authority.

Details of each item in the audit tool and suggested actions are detailed below.

A1.1.1 Type of path

A path/track/pavement has been designed for walking.

No path if there is no designated pedestrian area. For example, have to walk in the road.

Path forms useful and direct route: tick this option if the path forms a useful and direct route to other routes.

Path is disjointed: tick this option if the path does not form a useful and direct route to other routes, for example, if you have to cross the road multiple times in order to stay on the path, or if the path is not continuous.

A1.1.2 Slope

Mostly level: means no noticeable gradient.

Slight gradient: means gradient is noticeable but not steep.

Steep: means very noticeable gradient, difficult to walk up.

A1.1.3 Path conditions and smoothness

Poor

Moderate

Good

Under repair

A1.1.4 Path material

Asphalt in good condition is the most suitable surface for good grip and least changes in levels. Asphalt/bitumen – black-top (tarmac) pavement (Figure A1).

Figure A1. Bitumen pavement

Paving blocks (small) and paving slabs (larger) (Figure A2).

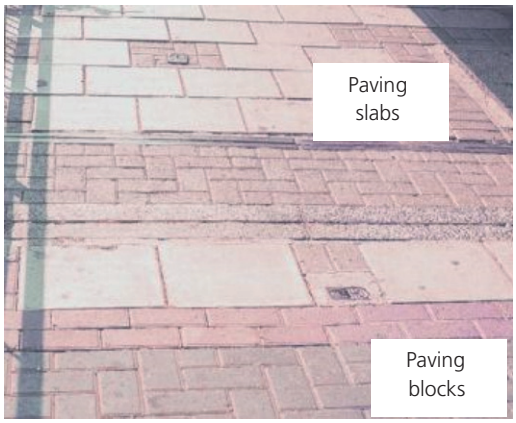

Figure A2. Paving blocks

Setts are uncomfortable and likely to cause loss of balance (Figure A3).

Figure A3. Setts

Hoggin (bound gravel or sand creating a firm and smooth surface) can be good for grip but can also cause loss of balance depending on the roughness of the surface (Figure A4).

Figure A4. Hoggin

Many older people find tactile paving uncomfortable to walk on and likely to cause loss of balance or be slippery (Figure A5).

Figure A5. Tactile paving

A1.1.5 Width of pavement

This refers to the width of pavement that is available for walking – it will therefore be reduced if cars are parked on the pavement.

Attention should be paid to how the individual feels about the pavement width. In a busy area, this might be problematic but in residential streets some people may prefer the narrow pavement as they can use the wall for support or feel less exposed.

A1.1.6 Permanent path obstructions

Obstructions such as poles, signs, tables and chairs are considered permanent if they cannot be moved – for example, if they are fixed to the ground.

Such obstructions can make a route difficult to negotiate.

A1.1.7 Steps

A route involving steps may be difficult, especially if the steps are deep, unevenly spaced or there is no handrail.

A1.1.8 Road crossing

Is there a raised kerb between the road and pavement? That is, is the pavement on a higher level than the road?

A1.1.9 Temporary obstructions

These may include leaves or sitting water, dustbins left out for collection, litter or scaffolding. Report the situation on the day of the audit.

A1.1.10 Street lighting

Are the street lights well maintained and working?

A1.1.11 Weather

Wet and icy weather will affect pavement surfaces and may result in wet leaves and sitting water.

Wind can cause loss of balance.

A1.1.12 Notes

Write notes (and take photographs) of anything that you are unsure about. Write enough notes so that your query is clear.

Many of these factors are inter-linked, for example, pavement setts may only be a problem in icy weather, paving slabs only if poorly maintained. The tool is designed to build a picture of the local environment and decide the best way to mitigate any adverse effects.

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