Environmental and Behavioral Circumstances Associated With Falls at Home Among Healthy Elderly Individuals

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Objective: To conduct an in-depth examination of the environmental and behavioral circumstances associated with falls and near-falls experienced by elderly individuals and to evaluate the usefulness of reenactment as a method for studying falls.

Design: Observational and self-report data of incidents were obtained through a reenactment procedure. Environmental characteristics were documented with physical measurements, visual inspection, and photography.

Setting: Incidents occurred inside participants' homes, and reenactments were conducted at incident sites.

Participants: Subjects were 15 community-dwelling, relatively healthy individuals, age 70 to 81 years.

Main Outcome Measures: Incidents were analyzed to determine patterns of interaction of individuals' personal characteristics, environmental use behaviors, and environmental characteristics.

Results: Seven patterns were identified: collisions in the dark, failing to avoid temporary hazards, preoccupation with temporary conditions, frictional variations between shoes and floor coverings, excessive environmental demands, habitual environmental use, and inappropriate environmental use.

Conclusions: There is a dynamic interaction between environmental conditions and behavior involving use of the environment and its implications for falls in older people. Although some incidents involved familiar environmental and behavioral risk factors, less familiar factors also were critical contributors to the incidents. Successful elimination of these factors is likely to be closely related to an individual's perception that an environmental or environmental use problem is correctable, motivation to undertake changes in the environment, and a desire to integrate changes into daily activities.

FALLS AMONG ELDERS are a widely documented public health problem. About one third of persons over age 65 who live in the community fall each year.[1,2] Community elderly experience an average of 0.5 falls per person annually; among elders in nursing homes there is an average of 1.7 falls per bed annually.[3] Although some falls may result in serious injuries and death, falls also can have more insidious consequences, such as negative psychological impacts that result in self- or other-imposed restrictions on independent functioning and daily activities.[1,2,4]

Most recent research into falls has recognized three broad domains of causal factors: personal factors (eg, chronic disorders and neurological deficits), environmental factors (eg, obstacles in a path of travel), and behavioral factors (eg, activities and choices that can destabilize balance, such as running or wearing improper shoes). Personal, environmental, and behavioral variables have been the subject of much study involving older people living in the community, as well as of persons residing in long-term care settings.[2,5-8] Personal factors that place older individuals at risk of falling have been widely studied.[6,7,9-16] In addition, there is a growing body of research on assessment methods and interventions to control or reverse personal risk factors.[17-25]

In contrast, although environmental and behavioral factors are often the most frequently cited circumstances associated with a fall, particularly among community-dwelling elders, far less has been published about the specifics of these factors, the mechanisms by which they can result in a fall, or how they interact with each other and with personal factors.[12,17,26] For example, it is widely accepted that stairs are an environmental risk factor for older fallers. However, research has not determined whether all stairs should be considered hazardous for older users or only stairs with structural deficits, such as missing handrails or irregular riser heights. There also is limited documentation on how to factor in other environmental conditions that are relevant to familiar environmental hazards. For example, what are minimal acceptable levels of illumination on stairs for older users; can some sources of light, such as windows adjacent to stairs, increase hazards? In addition, little is known about the interaction of environmental conditions and user behavior. For example, are stairs safe if users are attentive when ascending/descending; what about structurally sound stairs and inattentive users? Similarly, little is known about how personal factors affect safety during routine environmental use. For example, are structurally sound stairs hazardous for some elderly users because of interactions between medications they use and the cardiovascular demands stair use places on them?

Clearly, more information about environmental and behavioral interactions could be beneficial in defining the types of interventions that are effective in reducing falls risk and that are accepted and used by older individuals.

With these concerns in mind, the Atlanta Falls and Injuries Cooperative Studies on Intervention Techniques (FICSIT) study[27] created the opportunity to conduct an in-depth examination of the environmental and behavioral circumstances associated with falls and near-falls experienced by a subset of the participants in that study. The emphasis was on understanding, in detail, what happened—what roles environmental conditions, environmental use, and individual capabilities played in the incidents. A secondary purpose of the study was to evaluate the usefulness of reenactment as a method in falls research.

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We included near-falls as well as falls—defined as coming into contact with the floor or a lower level—to increase the number of incidents available for study. Also, an actual fall was not viewed as a prerequisite for studying persons' environment and behavior at the time they lost their balance.[28] Further, including near-falls permitted us to explore how environmental and behavioral factors contribute to loss of balance and how they may help individuals to recover their balance and not fall.

Our approach highlights the belief that falls and near-falls are due to (1) situational misfits among individual capabilities, (2) the functional and cognitive demands created by an individual's behavior immediately before the incident, (3) expectations for the outcome of that behavior based on prior experience, and (4) characteristics of the physical environment withing the individual's sensory range. This view, that falls are complex events with multifactorial antecedents, is an emergent one in falls research.[29] It is similar to the situational view of dependence in basic and instrumental activities of daily living described in the Environmental Press Model, and one that has proved useful in environmentally oriented research into stair falls.[10,30-33]

In emphasizing the situational view, we must (1) think about falls as events composed of interrelated parts and (2) preserve the resulting multifactorial patterns in analyzing those events or formulating intervention strategies. As in the Environmental Press Model, the relation between component parts, such as environmental characteristics and individual capabilities, is critical in understanding falls and near-falls. Because of the emphasis on interaction, there is less concern about whether components or characteristics of the physical environment or behavior are thought to be risk factors. Seemingly safe, as well as seemingly hazardous, environmental and behavioral factors may be relevant to explaining incidents, predicting situational risk, or developing interventions. This approach differs from the more common strategy of focusing on familiar environmental hazards, which are often limited to features posing obvious potential hazards for individuals of all ages, as a basis for identifying environmental risk factors in much falls research.[17,34-38] Finally, a situational view may answer the questions, "Why did a fall or near-fall occur on a specific occasion of engaging in a routine, frequently repeated activity, in a familiar setting? Of the many times that an individual rises from a chair, walks across the floor, gets out of bed, or reaches for a dish, why did he or she fall or nearly fall on this occasion?" In short, a situational view helps researchers recognize and problem-solve these types of environment-behavior dynamics.

Accordingly, because home assessments to identify needed safety modifications play an important role in decision-making about independent living for older individuals, this article should help rehabilitation specialists better understand a multifactorial approach to assessing falls hazards and planning safety modifications in the homes of older people. For clinicians with research interests in factors contributing to falls, the article illustrates one approach to overcoming difficulties encountered in implementing research based on a situational view of falls. The data and descriptions provide greater insight about the complex nature of falls and suggest an approach to preventative assessments and analysis of prior incidents. These analyses may be viewed as a basis for quantitative schema that allow more comprehensive assessment of home safety—an issue having far-reaching public health and physical rehabilitation implications.

METHOD

Study Participants

A total of 52 fall and near-fall incidents in the home were reported by 39 participants in the Atlanta FICSIT study over a 13-month period. The reporting procedure entailed immediate contact with the FICSIT project coordinator and completion of a brief incident report describing the location and circumstances of a fall or near-fall. The coordinator, in turn, notified the authors so that detailed ascertainment of the health of the subject and environmental/behavioral factors could be undertaken rapidly. The incident reports identified whether an incident occurred in the home or elsewhere. Individuals experiencing incidents in the home were contacted to solicit their participation in this portion of the study.

Fifteen individuals (19 incidents), of the 39 reporting an incident, participated in the portion of the FICSIT study reported here. The other 24 did not participate for a variety of reasons. Four individuals (8 incidents) had declined to participate in an earlier assessment of residential environmental characteristics and were not recontacted. Seven individuals (9 incidents) declined to participate in this portion of the study. Nine individuals (9 incidents) could not be reached to arrange participation within 6 weeks of the incident. Four individuals (7 incidents) were excluded for miscellaneous reasons, such as the distance to one individual's home from Atlanta and another's limited fluency in English.

The participants ranged in age from 70 to 81 years old. All participants reported that they were fully independent in use of the telephone, taking medicine, and money management. Some individuals reported the need for some assistance to travel to places out of walking distance (n = 1), grocery shopping (n = 2), meal preparation (n = 1), housework (n = 3), and laundry (n = 1). One third or more of the respondents reported they walk shorter distances or rest often (n = 5), use handrails when walking on stairs (n = 6), ascend and descend stairs more slowly (n = 6), and walk more slowly (n = 8) than they used to. Few reported any self-imposed restrictions on mobility and home range. In general, the participants were in good health. None reported a prior heart attack and only one reported a prior stroke, although one third reported taking medications for hypertension. Nine (60%) reported a history of cancer, 27% had a chronic respiratory disorder, 40% had a cataract, and 33% had experienced a fracture since age 50. Three individuals (20%) reported a problem with bowel or bladder incontinence. Arthritis was the only widely reported health problem (87% of respondents) with finger/wrist/hand, spine, and knee joints those most commonly reported as involved.

Fall and Near-Fall Incidents

Initially, individuals who reported multiple falls and/or near-falls in the home were contacted after each reported incident. When some, but not all, of those who reported multiple incidents agreed to successive follow-up interviews, the contact procedure was changed to solicit participation only after the first reported incident. A total of 19 incidents, experienced by 15 participants, were documented. Four incidents experienced by the participants were not investigated.

The location of 51 of all incidents (n = 52) reported as having occurred in participants' homes were identified from the incident reports. The locations of these incidents, as well as the subset about which participants were interviewed (19 incidents), are listed in table 1.

About one third of all incidents and half of those about which participants were interviewed occurred in bedrooms. About 10% of all incidents as well as 10% of those analyzed in this portion of the study occurred in kitchens and bathrooms. Eighteen percent of all incidents and 16% of those reenacted occurred in living rooms and dens/studies. The small percentage (10%) of all incidents that occurred in bathrooms is somewhat surprising in light of the general assumption that bathrooms are

Table 1: Location of Incidents

Location	All Incidents (n = 51)	Reconstructed Incidents (n = 19)
Bedroom	16 (31%)	10 (53%)
Stairs	5 (10%)	0
Threshold at door to exterior	6 (12%)	1 (5%)
Kitchen	5 (10%)	2 (11%)
Bathroom	5 (10%)	2 (11%)
Den or study	5 (10%)	3 (16%)
Living room	4 (8%)	0
Hall	3 (6%)	1 (5%)
Utility room	1 (2%)	0

hazardous and a common location for falls. Twelve percent of all incidents and 5% of those reenacted occurred at thresholds, both between rooms and at exterior doors. Half of these incidents occurred at the same doorway and were experienced by a couple participating in the larger study. They had declined to participate in the earlier environmental assessments and were not contacted for this portion of the study. It seems likely, however, that this threshold had some intrinsically hazardous characteristics. Additionally, although about 10% of all reported incidents (5 incidents, 5 participants) were falls or near-falls on stairs, none of the individuals who agreed to participate in this portion of the study experienced a fall or near-fall on stairs. Two of those who experienced falls or near-falls on stairs declined to participate in this portion of the study, one had refused participation in an earlier part of the study, one was excluded because she could not be reached in a timely way, and one lived too far away.

Determination of Circumstances

The circumstances of the fall and near-fall incidents were documented in each participant's home by a trained interviewer using an accident reconstruction technique. A reconstruction approach has been used in accident analysis and prevention research and in studies of environment-behavior interactions during natural disasters.[39,40] It also has been used by expert witnesses to analyze incidents before giving testimony in litigation about falls injury.

Participants were interviewed at the location of incidents in the home. They were asked to reenact the incident (up to the point they felt comfortable doing so) and to verbally describe what they were doing immediately before and up to point of the incident. Observational and self-report data obtained through the reenactments were recorded in detailed field notes and sketches.

The reconstruction interview technique resulted in observational data about how individuals were interacting with the environment at the time of an incident. This included global patterns of activity, such as walking from the bed and toward the bathroom, as well as more fine-grained body movements that involved environment and behavior interactions, such as hand and foot placement when rising from a chair. As they reenacted an incident, participants also typically provided a running commentary that verbally described their perceptions of the circumstances, activities, and body movements that immediately preceded the incident. Thus, observational and self-report data about the same incident emerged in tandem. Apparent omissions in verbal reports, as well as contradictions between what was being said and demonstrated body movements, were clarified through follow-up questions. The technique also yielded self-report data about unobservable conditions, such as preoccupation or dizziness at the time of an incident.

Objective characteristics of environmental features at the site of the incident also were obtained during the visit to each participant's home to conduct the reconstructive interview. These characteristics included physical measurement of environmental features needed to produce dimensioned floor plans with furniture and, where appropriate, wall elevations. (Floor plans show the size of objects in the horizontal plane and that of clear floor space between objects; elevations show the height of objects above the floor, such as the height of a closet shelf, top of a lavatory, or stair riser.) In addition, photographs were obtained of the location of the incidents.

Analysis

The interviewer's field notes and sketches were reviewed by another team member who prepared a text-based description of each incident that integrated the observer's notes and the participant's commentary. Preliminary text descriptions were compared with sketches of the location of the incident to ensure there were no inconsistencies between descriptions of how incidents occurred and descriptions of where they occurred. Finally, the text descriptions of the incidents were reviewed by the interviewer to ensure they were an accurate representation of information obtained during the incident reenactment.

A qualitative approach was used to identify patterns of environment and behavior circumstances from the incident descriptions.[41] This approach is similar to that used to analyze videotaped records of naturally occurring stair falls and reenactments of environment-behavior interactions during natural disasters.[33,39] The analysis of incident descriptions entailed careful, line-by-line reading of the incident descriptions to identify the defining environment-behavior interactions of each incident and the circumstances that set the incident apart from routine nonevents, for example, navigating a familiar route in the dark but nonetheless walking into a piece of furniture near the route. This review resulted in a series of thematic categories. Individual incidents with the same global theme were grouped together. For groups with multiple incidents, the descriptions were reviewed again to determine if there were important similarities and differences among the incidents. The groupings were treated as the patterns of environment-behavior circumstances associated with falls that are described below. These patterns are summarized in table 2.

Physical measures data and notes from the visual inspections also were reviewed to determine if there were any environmental characteristics that posed apparent hazards (ie, the problems often included in home safety checklists, such as slippery scatter rugs and extension cords). These materials also were reviewed to identify situations that limited clear floor space and room to maneuver in the event of a misstep, such as small bathrooms and walking paths narrowed by overfurnishing or clutter.

RESULTS

The reconstructive technique proved effective in the reenactment of 18 of the 19 incidents. One could only be partially reenacted because the individual blacked out during the incident and had poor recall of the event. The majority of incidents

Table 2: Patterns of Environment and Behavior Interactions

Pattern	Frequency
Collisions in the dark	3
Failing to avoid temporary hazards	2
Preoccupation with temporary conditions	2
Frictional variations in foot contact	2
Excessive environmental demands	7
Habitual environmental use	1
Inappropriate environmental use	2

occurred while individuals were engaged in routine behaviors, such as dressing and traveling familiar routes (eg, going from the bedroom to the bathroom). Contrary to popular opinion, few of the incidents involved behavior that might be labeled as hazardous. The patterns of environment-behavior circumstances associated with falls and near-falls experienced by the sample, including a detailed description of a typical incident, are presented below.

Collisions in the dark. Three incidents involved collisions with furniture while walking to and from bedrooms at night in the dark. All involved navigational errors on familiar nighttime routes.

A woman was getting out of bed at night to go to the bathroom. She did not turn on the light. The bed was angled in one corner, with the bathroom door near the foot of the bed. The clear path to the bathroom paralleled the length and width of the bed. The path along the side of the bed was between the bed and a chair, also placed at an angle and about two and a half feet from the bed at its closest point. As the individual sat on the edge of bed, she put her feet onto the floor and stood up. Her first step was with her left foot. After the first step, she estimated that she was about one foot from the edge of the bed. She began to swing her right foot forward. Her weight was resting on her left foot and her body was beginning to move forward. As her right foot passed the left, it caught on the corner of the small chair near the bed, which normally would have been to the right of her path of travel. Her foot continued to move forward, carrying the chair with it. The upper part of her body pitched forward and her hands swung to the front of her body. She untangled her right foot and took a large step forward. Her right foot landed with greater than usual force. Her body continued to move forward, dragging her left foot ahead. With her outstretched hands, she caught the front of a clothes dresser that was placed perpendicular to her path of travel. This maneuver stopped her forward motion. While still holding onto the dresser, she was able to pull her feet forward, under her body, and push herself into an upright position.

This incident likely resulted from the location or angle on the side of the bed from which the individual arose. It seems likely that on this occasion she sat up closer to the foot of the bed or more perpendicular to the edge of the bed than was her normal habit, but did not detect this difference in her location/orientation because of darkness. A slightly different starting point for the usual path and angle of travel carried her into the front edge of a chair, rather than along its side.

Failing to avoid temporarily hazardous conditions. Two incidents occurred when individuals failed to detect and avoid temporary obstructions of normally unobstructed routes of travel.

A woman was standing at the edge of her bed with her feet slightly apart. She rotated her body and feet counterclockwise to turn and walk out of the room. As she lifted her right foot to begin walking in a straight path toward door, it caught on a telephone cord. (She had moved the telephone the last time she used it, and had not put it back in its usual location. The cord was unintentionally left in her path of travel.) The cord tightened and stopped the forward motion of her foot. Her body continued moving forward. She threw her hands in front of her body as it moved slightly to the left and forward. The woman was uncertain if she twisted to the left because of the rotation of her body or in an attempt to avoid falling on a nearby chair. She fell on her hands and then her knees.

The second incident involved a woman who tripped over a space heater cord that crossed a normally unobstructed path of travel.

Preoccupation with temporary conditions. Two incidents involved excessive attention to a temporary condition, which led the individuals to ignore or overlook other potential hazards. Both incidents are reported here to illustrate preoccupation with a temporary injury and preoccupation with a short-term task.

A woman was sitting at her home desk, facing forward. She rotated her body to the left in the armless chair to stand up (ie, rather than push chair back). Her right foot, which was injured at the time, was placed next to the left front chair leg. The woman stated that she was very conscious of what she was doing with her right foot, because she did not want to hit it on the desk as she stood. She placed her left hand on the back of the chair and her right hand on the desk top to push herself to a standing position, presumably to limit the weight placed on her injured foot as she stood. As she reached a standing position, she fell forward. The hem of her robe was caught under the chair leg, which prevented her from standing fully upright. When she attempted to stand upright, the robe "jerked" her upper body forward. She fell toward a nearby sofa. Her left hand grabbed the sofa to partially disrupt her fall. Her right hand hit the floor.

A man was carrying a large box and walking backwards beside a bed. His knees were slightly bent and arms completely extended as he carried the box at hip level, slightly to right of center. His gait was stilted, moving one foot back, and inching the other foot back until he could feel the opposite one. As he moved past the bed, his left heel caught on books protruding from under the bed that were being used to elevate the foot of the bed. His upper body continued to move backwards and his right knee became more bent. The box shifted further to the right. His feet remained stationary. He fell to the floor on his right hip.

In the first incident, the woman was so preoccupied with not hitting a painful foot that she failed to notice that her robe was caught under her chair in a way that constrained her ability to stand upright. In the second incident, the man described and demonstrated this incident in a way that suggested his movement was self-consciously cautious as he carried a hard-to-handle box. It seems likely that he was so preoccupied with balancing the box while walking backwards that he either forgot about the books used to elevate the bed or misjudged where he was in relation to them.

In both cases, situation-specific circumstances contributed to the individuals' inability to recover their balance. In the first incident, seemingly carefully chosen hand placements for pushing up out of the chair could not be converted into handholds to slow the individual's forward motion and enable her to return to a seated position. To some extent these difficulties also may reflect slowed responses and awkward body movements related to the foot injury. In the second incident, the individual's arms were not available to steady his balance, to reach for a handhold, or to break his fall.

Frictional variations in foot contact. Two incidents entailed pivoting on floor surfaces that, in conjunction with shoe soles, offered enough resistance to result in the lower part of the body turning more slowly than did the upper part of the body.

A woman was standing at the kitchen sink, facing the sink but not holding onto the counter. She was standing on a semicircular, nonslip rug in front of the sink. She shifted her weight to the balls of her feet and began to rotate her body clockwise, forcing her feet to pivot. The friction of her feet against the rug resulted in her feet pivoting more slowly than did her body. After her body had turned about 30°, she began to lose her balance. It was unclear whether the manner in which she rotated her body alone resulted in a loss of balance or if the jerky motion of her body made her dizzy, which compromised her

balance. She reached her right hand across her body and grabbed the counter and steadied her balance.

The resistance between shoe soles and floor covering slowed the rotation of the body while the individual was pivoting, resulting in a split in the orientation of the upper and lower parts of the body, with the upper body oriented in a different direction than was the lower body. In effect, on attempting to rotate, the shoes held the feet and lower body in place while the upper body turned. The woman was unable to step out of the turn to achieve a stable stance, grabbing the counter instead to maintain her upright position. Because she was standing close to lower kitchen cabinets, she may not have had enough room to easily reposition her feet. In another incident not described here, an individual was able to recover her balance by repositioning her feet and widening her stance.

Excessive environmental demands. Six incidents involved situations in which the environment placed demands on an individual that exceeded his or her physiological capabilities (eg, leg strength, step height) to respond to those demands. These incidents varied in terms of the types of demands and included attempting to step over a doorway threshold that was higher than a typical step, stumbling over a quasipermanent obstacle at the edge of a travel route, and entangling feet with furnishings. Other incidents involved sudden foot and ankle pain, likely precipitated by activities, and insufficient functional reserves to overcome the resulting loss of balance. These incidents occurred in locations in which there was inadequate environmental support (eg, handholds) to compensate for loss of balance. A seventh incident, in which a woman blacked out while working at the kitchen counter and for which limited details could be ascertained during the reenactment, might have been another example of excessive demands or inadequate environmental support if, for example, she had been reaching to retrieve or replace items. The latter incident also might be an example of the next category, Habitual Environmental Use.

A woman was standing in front of a bedroom closet with her arms at her side. Her feet were together and in front of, but perpendicular to, the edge of a large area rug. She was wearing backless bedroom shoes (ie, "mules"). The area rug filled the space between the foot of two twin beds and a dresser and closet door on the opposite wall. The front legs of a dresser and the twin beds rested on the rug, limiting its movement on the floor. There was approximately two feet of hardwood floor between the edge of the rug and the front of closet. As the woman slid her foot backwards, the sole of her left shoe slipped under the edge of the area rug. She attempted to free her foot by lifting it up (ie, pulling upward against the shoe to bend the sole down). Instead, her body pitched backwards, which caused her to lose her balance. Her right hand grasped the dresser beside the closet door and her left hand grasped the closet door frame. These hand holds prevented further backward movement. She was then able to safely free her shoe from the rug.

In this incident, the individual chose the more demanding of two apparent ways to free her shoe. She tried to force the shoe sole to bend by lifting her foot, rather than sliding her foot forward and out from underneath the rug. The former required more strength, particularly because the rug was anchored by several pieces of furniture. The individual apparently lacked the strength to make the maneuver successfully. The incident was directly related to sliding her foot backwards, rather than stepping backwards, and wearing backless shoes. If she had been barefooted or wearing enclosed shoes, it is unlikely that the incident would have happened. The individual's proximity to the dresser and closet door frame and quick reaction in grabbing them prevented her from falling.

Habitual environmental use. Two incidents were identified in which individuals were engaging in routine activities, sitting down on the toilet and putting on pajamas, under conditions which appeared to create excessive environmental demands relative to individual capabilities. These incidents emphasize some of the problems older individuals often encounter when environmental characteristics and habitual ways of conducting daily activities do not change, despite changes in an individual's functional or sensory capabilities.

A woman was facing the lavatory with the tub at her back. She bent at the hips to pull her gown up before rotating and sitting down on toilet. Her knees may have been bent. She was not holding on to anything as she bent over. Although leaning forward, the individual believes that her weight shifted backwards and she fell into the tub. She landed on her buttocks with her legs resting on the front edge of the tub. Her husband had to remove the sliding door on the tub before she could extricate herself. The woman could not remember if the light was on when the fall occurred.

In the incident described here, the individual bent forward to catch the hem of her gown prior to sitting on the toilet. This movement apparently was routine. Although she did not report any dizziness, it is possible that bending over from a standing position, shortly after rising from bed, contributed to the fall. The size of the bathroom may have contributed to the outcome of the incident. The open floor space in the bathroom was limited and if the individual had been able to step backwards into open space, rather into the side of the tub, she may have regained her balance.

Inappropriate environmental use. Almost any environmental object can pose hazards if used inappropriately. In other words, the danger is as much, if not more, attributable to poor judgment as it is to environmental characteristics. One incident illustrates this type of situation.

A woman was standing in her bathroom facing the tub, intending to lift her left foot into the sink, which was located adjacent and at a right angle to the length of the tub. She reported that her back was stiff throughout the following movements. Her feet were slightly apart and her legs were about 3 to 4 inches from the adjacent sink. She leaned over and grabbed her left calf with her left hand. Holding her upper body rigid and holding onto the sink with her right hand, she lifted her left leg. As she lifted her leg, she rotated her body clockwise toward the sink. Her right knee was slightly bent. To achieve the height needed to clear the lavatory, she arched her head and torso backwards slightly. With her left foot in the sink and standing on her right foot, she released her hand hold on the sink to wash her left foot. She leaned forward as she washed her foot, and her body continued to rotate clockwise. She began to lose her balance, and grabbed the shower curtain with both hands, pulling the shower curtain rod loose from the wall. This seemed to accelerate her rotation and pulled her foot from the sink. The individual fell into the tub and landed on her left hip and hand, with her feet hanging over the side of the tub. She reported that while she was maneuvering her foot into the sink her attention was on a TV program playing in next room.

Although the height of the bathroom sink (31 inches) is slightly lower than standard (32 inches), neither height is intended to make the sink convenient or safe for use in the manner described above. To get her foot in the sink, she had to raise it waist-high while arching her head and upper body backwards. Once she had it in the sink, she was standing on one foot and had obvious problems centering her upper body mass over this foot. Using both hands to wash her foot precluded holding on to the sink as a means to steady her balance while standing on one foot. The TV program likely distracted her from a difficult and complex balancing act.

DISCUSSION

All of the participants were older people who lived independently in the community with only a modest degree of loss of functional capabilities and strength/stamina. The falls and near-falls they experienced provide new insights into the role of environmental factors and the importance of how individuals perceive and use the environment during daily life.

The incidents reconstructed as part of this study occurred in locations similar to those experienced by the total group, with the exception of incidents on stairs. Although it is unfortunate that none of those who experienced falls or near-falls on stairs were part of the study sample, stair incidents have been investigated more extensively using reconstruction and observational techniques than have incidents in other locations.[31,33] The findings from those studies are consistent with the limited information that is available from the incident reports about the stair incidents reported by FICSIT participants. Hazardous conditions, such as slippery materials on the nosing of steps, temporary obstacles, such as pets or stored items, and excessive environmental demands, such as navigating high stair risers when fatigued, all pose falls risk.

Several incidents involved collisions with furniture in the dark. The individuals seem to have misjudged their location and angle of travel. The darkness precluded their detecting and correcting these errors, and furniture layouts limited the magnitude of locational and navigational errors that could occur without a collision. Interventions targeted at increasing night time light levels or rearranging furniture to decrease the precision of safe travel routes are apparent approaches that would likely reduce or eliminate this type of incident. The fact that the individuals experiencing these incidents had not turned on a light suggests that they were accustomed to making these trips without a light, that they believed they knew the way in the dark, and that they were confident of their ability to make the trip safely. These attitudinal factors may be important barriers to an individual's awareness of the potential dangers of this situation or initiating changes to improve safety. More generally, these incidents are useful reminders that creating appropriate environmental conditions does not ensure that they will be used or used as intended. Professionals responsible for helping older individuals improve home safety should introduce techniques to modify existing attitudes and behavior that influence home safety. For example, one might introduce an easy-to-implement procedure to ensure night lights are used, such as a bedtime checklist. An alternative approach is to automate interventions where possible, such as by using night lights with photocells that operate when ambient lighting levels are low.

A second group of incidents was related to individuals' entanglement with temporary obstructions in paths of travel. Objects temporarily obstructing paths of travel, such as suitcases to be loaded in the car, a vacuum cleaner left in the hallway, or pets wanting to be fed, often are the by-products of daily life and reflect individual idiosyncrasies and long-standing habits. Temporary obstructions are different from the more quasipermanent obstructions noted in the literature, such as extension cords routinely left in paths of travel and clutter on stairs. Unlike quasipermanent obstructions, temporary obstructions cannot be permanently eliminated. They also may be difficult to identify on a case-by-case basis—many are at least temporarily eliminated when the house is cleaned before the arrival of a visitor, such as a therapist coming to conduct a home safety assessment. Such obstructions, although they may reoccur frequently, are usually short-lived. They are generally not thought of as hazardous, although failing to detect and avoid them—a situational problem—clearly is. Expectations that potential problems caused by temporary obstacles can be avoided if individuals pay careful attention to what they are doing ignores an important underlying consideration—many people of all ages safely move around familiar environments on the basis of experience, rather than on the basis of attentiveness to existing conditions. Thus, temporary obstructions probably cannot be fully prevented without radical and probably unacceptable changes in older individuals' lifestyles and habits. Individuals will not automatically be extra-attentive to such temporary conditions. Client education to help individuals recognize and modify habits that result in temporary obstructions and to increase sensitivity to one's immediate environment may be the most effective approaches to preventing this type of incident.

The incidents related to preoccupation with temporary conditions or selective perception about those conditions are an interesting contrast to those that entailed failing to detect and avoid temporary obstructions. The individuals preoccupied with temporary conditions seem to have been moving with care and concentrating on the task at hand, perhaps because of the physical demands of the task in comparison to individual capabilities. Although clearly exercising care about step-to-step foot placement, both individuals encountered problems when they overlooked an important part of the "big picture" of the task at hand. Collectively, the incidents involving preoccupation with temporary conditions, as well as those in which individuals failed to detect temporary obstacles, suggest that attentional extremes can create risks if individuals encounter unexpected obstacles.

Two incidents were related to footwear that resisted pivoting on rugs and carpets, which resisted moving underfoot. Individually, the slip-resistant qualities of both footwear and flooring materials are usually viewed as desirable. Together, however, they contributed to imbalance when individuals were attempting to pivot. Individuals who experienced these incidents differed in their ability to deal with the resulting imbalances, such as by stepping out of the pivot to create a more stable and wider base of support. Ability to step out of the pivot may reflect not only agility and other personal factors, but also available clear floor space for moving the feet. The presence of convenient, even if unintentional, handholds, such as the kitchen counter, helped to offset difficulties with stepping out of a pivot as a means to stabilize balance.

Two groups of incidents involved environmental conditions that placed excessive demands on individuals or did not provide adequate support for activities in the face of individual capabilities. In one group the environmental conditions that created excessive demands on individuals are fairly obvious and would likely be demanding for individuals of all ages (eg, stepping over a very high threshold). In the other group the misfit between individual capabilities and environmental demands may be less obvious, especially for older individuals, because the activities and their location are routine parts of daily life. As suggested by the Environmental Press Model, the routine inherent in daily activities may mask slow loss of capabilities and correspondingly slow increase in environmental demands, even in settings that have been used for years.[32] Excessive environmental demands may be further masked when some capabilities remain high although others have declined. For example, quick reaction time and the availability of nearby handholds played important roles in determining if individuals were able to stabilize balance that had been compromised because of the interaction of other capabilities and environmental features. Although these incidents appear to be largely related to declines in physical functioning, age-related changes in vision and proprioception, alone or in conjunction with other types of limitations, also can change the fit between environmental demands and

individual capabilities in terms of both risk of falling and opportunity to recover.

Environments can usually be modified to improve their fit with individual capabilities and thereby reduce environmental demands.[42] The FICSIT project and other studies have examined interventions to improve or stabilize physical functioning.[43,44] Modifying habits may pose the greatest challenge. Older people may resist changing old habits for a variety of reasons or even fail to recognize that old habits can pose falls risk. The power of old habits can present a major obstacle to efforts to enhance safety through behavior modification or environmental changes. For example, although an individual who changes into her pajamas standing in the middle of the bedroom floor could readily relocate this activity so as to routinely stand near a convenient handhold or to sit while changing (ie, modify the habit), the individual might fail to recognize the need for change.

As suggested above, incidents attributable to inappropriate environmental use often are the result of poor judgment. Sometimes, as was the case with the individual washing her foot in the bathroom sink, individuals engage in hazardous behavior by using the environment in an inappropriate manner that requires extraordinary physical ability to do so safely. Although not illustrated by any of the reported incidents, the physical or structural condition of a physical object also may make its use inappropriate. For example, using a stair rail when descending steps would usually be labeled as wise or cautious. However, if the stair rail was unsound, the wisdom of using it would be questionable. Often, falls referred to in the literature as attributable to environmental hazards—standing on wobbly stools and ladders—gloss over the potential contributions to these incidents of poor judgment and limited environmental awareness.

The near-fall incidents, as a group, deserve special mention. As occasions when a fall might have occurred but did not, near-falls may be a source of insight for clinicians about natural adaptive strategies that could provide the basis for more formalized falls prevention strategies. Little is known about the circumstances that distinguish falls from near-falls but it is likely that personal factors, such as quick reaction to loss of balance, and environment-behavior factors, such as available handholds, are relevant. In the near-falls examined in this study, the individuals may have been using natural adaptive strategies, capitalizing on serendipitous environmental resources, or both. Investigation of natural adaptive strategies as the basis of falls prevention strategies could be a productive direction for future research.

Finally, the reenactment process proved useful in eliciting detailed self-report and observational information about falls in home settings. In comparison to the descriptions provided in the incident reports, the reenactments provided additional information about circumstances of falls and near-falls and clarified the mechanisms of incidents. In general, the procedure often added critical information that the participant had omitted, perhaps thinking it to be unnecessary or irrelevant, or that the individual had not remembered. For researchers, reenactments transform the idea of falls and near-falls as complex, multifactorial events from an abstract conceptualization to a more tangible, observable, and imageable reality. The experience of using language to characterize and interpret the detailed circumstances of falls and their interrelationships raises questions about approaches that fragment these complex events. For clinicians, it offers valuable insights about assessment procedures as well as interventions that have the potential to be more individually effective.

CONCLUSIONS

The incidents reported here illustrate the dynamic interaction between environmental conditions, behaviors involving use of the environment, and personal factors and the resulting implications for falls in older people. Although some incidents involved familiar environmental and behavioral risk factors, the reenactments of these incidents suggest that less familiar factors also were critical contributors to the incidents. Elimination of these conditions, as part of a strategy to prevent future incidents, is likely to be closely related to the following issues: the individual's perception that an environmental or environmental use problem is correctable; motivation to undertake changes in their environment; and recognition of how these changes can be readily and successfully incorporated into daily activities.

In our efforts to continuously seek ways to reduce falls incidents among older people in the community, we need to ensure that home safety assessment procedures go beyond the application of environmental hazard checklists and examine environments in use. We also need to educate the older population to recognize the dynamic interactions between the physical environment and their daily activities, helping them to understand that beyond making necessary changes in their home environment, they must be willing to use those changes. Once environmental modifications are made, individuals may benefit from procedures that prompt use of the new safety features.

An important fallacy to overcome is that once a home safety assessment has been completed and the identified risk factors have been corrected, home safety problems are solved. Because of the dynamic interactions among an individual's capabilities, his or her patterns of environmental use, and the characteristics of the individual's home environment, the risks posed by environmental and behavioral conditions may change over time. Older individuals and their families need to be provided with the skills to conduct their own periodic reassessments of home safety to identify emerging needs and be encouraged to use these skills.

In summary, to improve the effectiveness of home assessment procedures in reducing falls risk, we must work not only to change the environment but also to identify associated behaviors requiring change, serve as facilitators for encouraging such changes, and incorporate a dynamic view of the role of the physical environment and its use into the education of our students as they learn about falls risks.

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