Central European Journal of Nursing and Midwifery

Cent Eur J Nurs Midw 2019;10(2):1019–1025
doi: 10.15452/CEJNM.2019.10.0009

ORIGINAL PAPER

THE EFFECT OF EDUCATIONAL INTERVENTION BY NURSES ON HOME ENVIRONMENTAL RISK FACTORS FOR FALLS

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Received September 26, 2018; Accepted February 26, 2019.

Abstract

Aim: The purpose of this study was to assess the incidence of environmental safety hazards in the homes of people aged 65 years and above, and to evaluate the effect of an educational intervention by nurses on the incidence of home environmental risk factors for falls, and on the perception of the safety of the home environment. *Design:* The study was a non-randomized single-arm pre-post intervention study. *Methods:* The sample consisted of 106 elderly patients living in their homes in the Czech Republic. The intervention involved individual education about home hazards, including the provision of a free educational leaflet and emergency call sticker, and advice regarding home environment modification and safety devices. *Results:* A statistically significant difference was found in the number of risk factors before and after the intervention ($p < 0.001$). After the intervention the elderly subjects perceived their home environment as being less safe than they had before. *Conclusion:* This study demonstrates that home environmental risk factors for falls can be reduced by a well-prepared educational intervention.

Keywords: accidental fall, education, elderly, home environment, risk factor.

Introduction

Falls among the elderly living at home are a serious problem. They are associated with significant mortality and morbity, and frequently lead to a decrease in physical and psychological functioning (Akyol, 2007). Many studies on fall prevention have been published not only in an international context, but also, in recent years, in the Czech Republic and Slovakia. Most of these papers focus on fall prevention in a hospital (Zeleníková, Kozáková, Jarošová, 2016; Bóriková, Tomagová, Žiaková, 2017; Bóriková et al., 2018) or community setting (Dingová, Králová, 2017). Despite the many published papers on fall prevention, a high percentage of elderly people still fall in their homes. Falls occur as a result of a complex interaction of risk factors (WHO, 2007). The major risk factors for falling are diverse, and many of them – such as balance impairment, muscle weakness, polypharmacy, and environmental hazards – are potentially modifiable (NICE, 2013). Falls in the home environment often result from the interaction between environmental factors and physical abilities (Lord, Menz, Sherrington, 2006). Factors related to the physical environment are the most common cause of falls in the elderly, responsible for between 30–50% of such incidents (WHO, 2007). The physical home environment therefore plays a significant role in many falls.

Prevention of falls at home consists mainly of the careful assessment of home fall hazards, and their modification. Home hazards are among the most predictive risk factors for falls in community-dwelling elderly people, together with fall history, gait deficit, balance deficit, mobility impairment, fear, visual impairment, cognitive impairment, and urinary incontinence (NICE, 2013). Important modifiable environmental risk factors include lighting, stair and bath rails, clutter, gait aids, and wet surfaces. It seems only reasonable to modify the home environment to prevent or decrease the number of falls. Futhermore, unlike interventions that target health and behavioral factors, environmental modification has the potential to decrease the risk of falls for every person using the safer environment (Fabio, Chaudhury, 2008). Although some studies focus on modification of the home environment to prevent falls, this is a critically neglected area of research. In their systematic review, Hignett, Edmuns Otter, Keen (2016) conclude that as homecare becomes more common, there is a need to ensure the safety of both patients and caregivers through increased understanding of the physical

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interactions and tasks entailed in managing safety risks and planning safer care delivery systems.

Prevention-of-falls programs aim to increase functional capacity, decrease the number of falls, prevent falls, and decrease fall-dependent injuries. Fall prevention interventions include a review of older patients' medicines and potential environmental hazards, as well as evaluation and treatment of blood pressure, vision problems and mental status changes, including depression (Akyol, 2007). Many studies have shown that home hazard assessment is an important part of fall prevention programs in home-dwelling elderly people (Sjösten et al., 2007). In their meta-analysis, Clemson et al. (2008) found that home environmental interventions were associated with a 21% decrease in the risk of falls. Careful assessment and modification of fall hazards can decrease the frequency of falls.

Home assessment and safety modification is a relatively new component of fall intervention and prevention programs. Based on the current evidence and the public health investment in keeping older adults living in a safe home environment, several suggestions can be made. For instance: that a home safety and hazard assessment be conducted; that revisions in building codes to include features designed to reduce fall hazards be promoted; that older dwellings be retrofitted with protective and safety devices; and that it be ensured that new constructions include safety devices and other relevant features (Newton, 2006).

The chief objective of the assessment is to maintain the person's ability to function in a safe environment by developing and implementing effective strategies to reduce hazards and fall risk factors, and to improve accessibility (Newton, 2006).

A small number of studies have demonstrated effective home-modification interventions (Wyman et al., 2007; Fabio, Chaudhury, 2008). Most of these studies are not recent, although a number are new (Keall et al., 2015; Ritchey, Meyer, Ice, 2015). In a Cochrane review focusing on the effectiveness of different interventions in the prevention of falls in the elderly living in the community, home-safety assessment and modification interventions were shown to be effective in reducing the rate and risk of falls (Gillespie et al., 2012).

Based on the studies reviewed, Fabio, Chaudhury (2008) proposed "multifactorial falls risk" as a conceptual framework. When applied, this framework reveals that an individual´s risk of falling can be determined by the interaction of three main factors: mobility, behavior, and physical environment. In general, as mobility decreases, risk-taking behavior increases, and the physical environment becomes unsafe, with the risk of falls increasing from low to very high risk. Therefore, if an older adult has high mobility, minimum risk-taking behavior, and is in a safe physical environment, he/she will be at low risk of falling. Our study takes this framework as its theoretical basis.

Aim

The aim of this study was to assess the incidence of environmental safety hazards in the homes of people aged 65 years and above, and to evaluate the effect of an educational intervention by nurses on the incidence of home environmental risk factors for falls, and on the perception of the safety of the home environment.

Methods

Design

A quasi-experimental (nonrandomized single-arm pre-post intervention) study.

Sample

A pilot study with ten elderly subjects was performed prior to the commencement of the study proper. The subjects comprising the pilot sample were not included in the study sample. Study participants included a sample of 106 elderly individuals aged 65 and above living in their homes, under the care of one of three selected homecare agencies in the eastern region of the Czech Republic. Participant inclusion criteria were: age 65 years or above; living in a home environment for the entire duration of the study; full or partial mobility; and informed consent of the elderly adult and/or family. If family members lived together with an elderly relative, they were also included in the research, and received education. Potential participants were excluded if they declined to participate in the study, or if they could not complete the study due to being hospitalized, changing their place of residence, or dying while the research was in progress. Participants were recruited in their homes through three selected homecare agencies. Initially, 110 elderly individuals and their families (if living together with an elderly relative) were invited by trained nurses to participate in the study, all of whom agreed. Participants and their families were motivated by the fact that they could potentially improve their home environments to make them safer, and thereby prevent falls. During the study, four elderly participants were excluded after being admitted to hospital. The final sample thus consisted of 106 participants.

Data collection

Data were collected from April to October 2013 in the home settings of the elderly subjects. Participating elderly adults were the clients of three selected homecare agencies in the eastern part of the Czech Republic.

Intervention

The intervention involved individual education about home hazards, including the provision of a free educational leaflet and emergency call sticker, and advice regarding home environment modification and safety devices (where to buy, and how to install them). The average time of each individual educational session was 60 minutes.

An educational leaflet focusing on fall prevention in the home environment and a sticker with emergency numbers were designed by the researchers before the educational sessions. The four-page educational leaflet contained useful and practical information, as well as illustrations regarding how to modify the home environment to make it safer. Information was organized into several sections: fixtures and fittings in rooms, bathroom and toilet, floors, corridor, stairs, lighting, windows, compensatory aids, footwear, pets in the home, other recommendations to prevent falls, and important phone numbers.

Twelve homecare nurses were trained to educate the elderly subjects and their families. Training focused on home environmental risk factors for falls, home environment modifications, and on the education of the elderly subjects and their families on fall prevention in the home environment. Training was conducted in a group in three different settings over a one week period. Each training session lasted 60 minutes. Of the 12 nurses who underwent training, only seven were involved in data collection and the education of the elderly study subjects. The remaining five nurses could not be involved in data collection during the whole research period due to organizational duties.

Measures

Baseline measures included age, sex, medical diagnosis, family status, living arrangements, chronic medication, and co-morbidity.

Before, and at 12 weeks after the intervention, data on home environmental risk factors and on the perception of the safety of the home environment were collected. The primary outcome measure was the number of environmental risk factors for falls within the home. Home environmental hazards were measured by conducting a room-by-room assessment using a checklist. This checklist of home environmental risk factors for falls was created with the aid of the following literature: Check of safety: a home fall prevention checklist for older adults (Stevens, Olson, 1999; National Center for Injury Prevention and Control, 2017), Fall Prevention Home Safety Checklist: What you can do to prevent falls (Minesota Safety Council, 2004), and Home Safety Checklist (Akyol, 2007). The checklist consisted of 34 home environmental risk factors. The assessment of home environmental risk factors was completed by trained nurses in 2013. The same nurses evaluated environmental hazards at the inception and, again, 12 weeks after the intervention.

The subjects' perception of the safety of their home environments was self-rated on a 5-point scale (1 = *the safest home environment* and 5 = *the least safe home environment*). This item was developed by the study investigators. A single item was chosen on the basis of simplicity and ease of use.

Data analysis

Means, standard deviation (SD), and absolute and relative frequencies were calculated for descriptive statistical analysis. Differences in each home environmental risk factor before and after intervention were compared. To calculate the effect of the intervention, the Wilcoxon pair test was used. A p-value < 0.05 was considered to be significant. The statistical analysis was performed using the Stata v. 10 (College Station, TX: StataCorp LP).

Results

Sample characteristics

The sample consisted of 29 (27%) men and 77 (73%) women. The mean age of the sample was 81 (SD = 5.3; age range: 67–96 years). The majority were widow/ers (62%). Forty-four percent had a history of cardiovascular disease. The majority of elderly participants lived with family members (79%). Patient characteristics are summarized in Table 1.

The average number of home environmental risk factors for falls before intervention was 15 (SD = 3.06), while the average number of home environmental risk factors for falls after intervention was 11 (SD = 2.58). A statistically significant difference (Table 2) was found in the number of home environmental risk factors for falls before and after intervention ($p < 0.001$).

Among the most frequent home environmental risk factors for falls before intervention were the following: no hip protector; no edge protectors on edges of furniture; no window safety locks; no night lights (bedroom, hallway, toilet); no handrails next to the door; emergency numbers not placed near

Table 1 Sample characteristics (n = 106)

Characteristics		n	%
Age group	65–74 years	8	8
	75–84 years	64	60
	≥ 85 years	34	32
Gender	male	29	27
	female	77	73
Family status	widow/er	67	62
	married	25	24
	divorced	8	8
	single	6	6
Main medical diagnosis	cardiovascular disease	44	41
	disease of musculoskeletal system	24	23
	metabolic and endocrinological disease	17	16
	neurological and cerebrovascular disease	15	14
	other diseases (sensory, respiratory, oncological)	6	6
Number of prescription medications	2–3	8	8
	4–8	71	67
	9 or more	27	25
Living arrangements	living alone	22	21
	living with family members	84	79

Table 2 The number of home environmental risk factors for falls before and after intervention

	median	mean	SD	min.	max.	p-value
Before intervention	15	15	3.06	9	24	< 0.001
After intervention	11	11	2.58	5	19	

SD – standard deviation

phone; no handrails along hallways; a high toilet seat not installed. The least frequent home environmental risk factors for falls before intervention were: electrical wires/cables and extension cords on the floor; polished and slippery floors; no light switches by doorways; and unstable furniture. The effect of the educational intervention was statistically significant for 22 home environmental risk factors for falls (see Table 3). The smallest effect after the educational intervention was observed in the following home environmental risk factors for falls: no hip protector; no handrails along hallways; low chairs; toilet with inward opening door; no light switches by doorways; unstable furniture; and no light switch for stairs (or only one switch – at the top or the bottom of the stairs).

On a scale from 1 (*the safest home environment*) to 5 (*the least safe home environment*), the average perception of home environmental safety before intervention was 2, rising to 4 after intervention. A statistically significant difference was found in perception of saftey in the home environment before and after intervention ($p < 0.001$). After the educational intervention, the elderly subjects perceived their home environment to be less safe than they had previously (see Table 4). Their awareness of home environment risk factors for falls was higher after the intervention.

Discussion

The main aim of the study was to assess the prevalence of environmental safety hazards in the homes of people aged 65 years and above, and to evaluate the effect of educational intervention by nurses on the prevalence of home environmental risk factors for falls, and on the perception of the safety of the home environment.

Study results showed that educational intervention caused a substantial decrease in the number of home environmental risk factors for falls. The effect of intervention was statistically significant for 22 home environmental risk factors for falls, for example: no edge protectors on edges of furniture; no night lights (bedroom, hallway, toilet); a high toilet seat not installed; no non-slip mats (bathroom and toilet); no seat in the shower or bath; no non-slip mats in wet areas; bed too low; carpet edges not secured; no handrails in the bathroom and toilet; unsafe and slippery footwear; bedside light not within reach; no non-slip tape on edges of steps, unsecured carpets; mats and rugs in the home; and electrical wires/cables and extension cords on the floor. These results prove that home environmental risk factors for falls are modifiable. Home modification prevents elderly people from succumbing to hidden fall hazards in the course of daily activities at home. Most falls among

Table 3 The presence of home environmental risk factors for falls before and after intervention

Home environmental risk factors for falls	Before intervention n (%)	After intervention n (%)	p-value
No hip protector	105 (99%)	103 (97%)	0.1573
No edge protectors on edges of furniture	104 (98%)	88 (83%)	0.0002
No window safety locks/guards	93 (88%)	84 (79%)	0.0027
No night lights (bedroom, hallway, toilet)	91 (86%)	69 (65%)	< 0.001
No handrails next to the door	91 (86%)	91 (86%)	1.0000
Emergency numbers not placed near phone	89 (84%)	4 (4%)	< 0.001
No handrails along hallways	84 (79%)	82 (77%)	0.3173
A high toilet seat not installed	82 (77%)	74 (70%)	0.0114
No non-slip mats, anti-slip tape (bathroom and toilet)	63 (59%)	43 (41%)	0.0002
No light fixture near the bed	62 (58%)	26 (25%)	< 0.001
Presence of thresholds (sills) in the apartment	60 (57%)	60 (57%)	1.0000
No non-slip extensions to the supporting utilities	58 (55%)	31 (29%)	< 0.001
No seat in the shower or bath	57 (54%)	46 (43%)	0.0023
No non-slip mats in wet areas, such as the shower or bath	55 (52%)	22 (21%)	< 0.001
Bed too low	53 (50%)	46 (43%)	0.0082
Carpet edges not secured	50 (47%)	28 (26%)	< 0.001
No handrails in the bathroom and toilet	49 (46%)	25 (24%)	< 0.001
Unsafe and slippery footwear	48 (45%)	14 (13%)	< 0.001
Bedside light cannot be reached	41 (39%)	18 (17%)	< 0.001
First and last step markers not present, Step edges hard to see	40 (38%)	33 (31%)	0.0082
Low chairs	32 (30%)	30 (28%)	0.1573
No non-slip tape on edges of steps, unsecured carpets	29 (27%)	21 (20%)	0.0114
Mats and rugs in the home	28 (26%)	18 (17%)	0.0016
Wall-mounted cabinets and shelves too high	25 (24%)	25 (24%)	1.0000
Phone too high (hard to reach)	23 (22%)	7 (7%)	0.0001
Toilet with inward opening door	22 (21%)	21 (20%)	0.3173
Proper handrails along the stairs not present	19 (18%)	19 (18%)	1.0000
Pets in household	18 (17%)	18 (17%)	1.0000
No light switch for stairs (or only one switch – only at the top or only at the bottom of the stairs)	14 (13%)	13 (12%)	0.3173
Chaotic crowded environment, clutter on the floor	13 (12%)	4 (4%)	0.0027
Unstable furniture	13 (12%)	12 (11%)	0.3173
No light switches by doorways	9 (8%)	8 (7%)	0.3173
Polished and slippery floors	7 (7%)	2 (2%)	0.0253
Electrical wires/cables and extension cords on the floor	4 (4%)	0 (0%)	0.0455

Table 4 Perception of safety of the home environment

	median	mean	SD	min.	max.	p-value
Before intervention	2	2.01	0.82	1	4	< 0.001
After intervention	4	4.07	0.76	1	5	

Note: rated on a scale from 1 (the safest home environment) to 5 (the least safe home environment); SD – standard deviation

elderly individuals living in their home environment occur indoors. Indoor falls occur most often in the bathroom, bedroom and kitchen (Akyol, 2007). The research of Pi et al. (2015) indicates that the bedroom is one of the most common sites of indoor falls, particularly among women. Frail elderly people tend to fall and injure themselves in the home during the course of routine activities (Akyol, 2007). Elderly adults and their families should be encouraged to alter their homes to try and reduce falls and fall-related injuries. Common alterations include the fitting of locks on cupboards, installation of stair gates, improvement of lighting in halls and stairways, and the removal of trip hazards (Turner et al., 2011).

The educational intervention had no observable effect on the following home environmental risk factors for falls: no handrails next to the door; the presence of thresholds (sills) in the apartment; no proper handrails along the stairs; wall-mounted cabinets and shelves too high; and pets in the household. Modification of these home hazards requires more effort.

A similar study was conducted by Wyman et al. (2007). They found that an intensive program of fall and home safety education, and individualized counseling led to only modest reductions in environmental hazards in a sample of elderly women who were at risk of falling.

Family members of individuals comprising the study sample generally addressed home hazards that were easy to modify. These included installing a high toilet seat, placing non-slip tape on the edges of steps and edge protectors on the edges of furniture, installing a light near the bed, and placing non-slip mats in the bathroom and toilet, among others. The targeting of family members, in addition to the elderly subjects themselves, was beneficial, as family members are probably better able to implement home modifications. The intervention was feasible, well-received and effective. Families were willing to participate in the study. They wished to improve the home environment to prevent falls, since they were convinced that home modification was beneficial.

An interesting finding of the study is that the home environment was perceived as being safer before intervention than after. This surprising result does not imply that the environment was actually less safe after intervention, but that the intervention caused an increase in awareness of potential fall risks in the home. It is important to note that perception was assessed using a subjective measure. Before the intervention participants lacked information regarding home risk factors.

Although we did not investigate the effect of educational intervention on fall rates, there are studies confirming that the greatest benefits of using home environmental interventions are associated with interventions targeted at high-risk groups (Clemson et al., 2008).

Dingová and Králová (2017) in their qualitative research among elderly Slovak adults found that those with high levels of fear of falling made adjustments to their homes and all participants limited their activities to some extent. The majority of participants avoided activities that were seen as highly risky and non-essential (unrelated to self-care).

According to Lord, Menz, Sherrington (2006), reducing hazards in the home appears not to be an effective fall prevention strategy in the general elderly population and those at low risk of falls. Home hazard reduction is effective if targeted at elderly people with a history of falls, and mobility limitations. Elderly people with fair (rather than poor or excellent) balance may be at greatest risk from household environmental hazards (Lord, Menz, Sherrington, 2006). In their systematic review, Turner et al. (2011) found that there is very little high-grade evidence that interventions to modify the physical home environment affect the likelihood of sustaining an injury in the home. Home hazard assessment is shown to be effective only in conjunction with follow-up and intervention, rather than in isolation (NICE, 2013).

Assessment of home environmental risk factors for falls can be a key intervention in fall prevention in elderly individuals living in their home environments. When followed by individual education and home environment modification it can reduce the risk of home hazards. Older people who have received treatment in hospital following a fall should be offered a home hazard assessment and safety intervention/modifications by a suitably trained healthcare professional. Normally this should be part of discharge planning, and should be carried out within a timescale agreed upon by the patient or caregiver and appropriate members of the healthcare team (NICE, 2013). The development of standardized assessment instruments and methods for reporting study outcomes on environmental hazards would enhance future research on home safety assessments and modifications programs (Wyman et al., 2007).

Limitation of study

The main limitation of the study was the lack of random assignment due to ethical considerations. The study was limited to a specific geographical location (the eastern Czech Republic). The recruitment rate for elderly people living in their homes was extremely high, suggesting that most elderly individuals and their families would welcome fall prevention programs.

Another limitation of the study is that perception of the safety of the home environment was measured by a single item. Internal consistency cannot be computed for a single-item measure. A single-item instrument provides clinicians with limited information about perception of the safety of the home environment by elderly individuals, but it can serve as a screening tool. Future research should focus on developing a multi-item instrument, measuring perception of the safety of the home environment.

We did not investigate the effect of a fall prevention program on fall rates. Additional work is needed to identify interventions that reduce the frequency of falls among elderly individuals living at home.

Conclusion

The study indicates a significant reduction in the number of home environmental risk factors for falls after an educational intervention. Several home environmental risk factors for falls were modified after

the educational intervention. Assessment of home environment hazards, in addition to educational intervention, can be a key component of fall prevention programs for the elderly living in home environments. This study demonstrates that home environmental risk factors for falls can be reduced by a well-prepared educational intervention.

Ethical aspects and conflict of interest

The institutional committee and the head nurses of each of the three homecare agencies approved this study. All participants gave informed consent prior to participation in the study. Before informed consent was obtained, the participant and family members were allowed ample time and opportunity to read the patient information sheet, to enquire about details of the study procedures, and to decide whether or not to participate. All participants were assigned an identification number.

The authors declare no conflicts of interest. The survey was part of a diploma thesis at the University of Ostrava.

Author contribution

Concept and design (PT, RZ), data collection (PT), manuscript draft (RZ, PT), critical revision of the manuscript (RZ, PT), final approval of the manuscript (RZ, PT).

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