

EFFECTIVENESS OF HOME VISITS FOR DWELLING ADJUSTMENTS IN PREVENTING FALLS AMONG OLDER ADULTS: AN INTERVENTIONAL STUDY

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Abstract

Background: Falls among older adults are a growing public health issue due to the aging population, leading to injury, disability, and mortality. Dwelling adjustment and continuous home care are proposed to reduce falls and improve the quality of life for older adults and their families. **Objective:** To compare the incidence of falls in older adults with and without home visit support and dwelling adjustments. **Methods:** A prospective randomized controlled study was conducted with patients over 70 years old in Surin province from January 1st to June 30th, 2022. 40 patients from each district were selected by random sampling and assessed for baseline fall risk scores. Patients were randomized to receive two home visits with follow-up monitoring of falls over six months. Nurses and physiotherapists conducted home visits, assessing mobility barriers, fall risk, and home safety using validated tests. A protocol for dwelling adjustments was implemented, including modifications to mobility aids, furniture placement, and the installation of railings and handlebars. **Results:** 638 patients participated, with an average age of 79 years. Among them, the 319 patients who received dwelling-adjustment home visits had a significantly lower incidence of falls ($P < 0.001$). The number needed to treat was eight to prevent one fall (95% CI: 6-12). **Conclusions:** The findings support the use of preventive, home-based interventions in older adult care. By reducing falls, these interventions improve the quality of life for older adults and reduce healthcare system burdens. A comprehensive approach, including clinical practice improvements, public health initiatives, and policy reforms, can significantly enhance fall prevention efforts.

Keywords: Dwelling Adjustment; Fall; Home Environment; Home Visit; Older Adults

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Introduction

Thailand is progressing into an aging society, over one-tenth of the population are over the age of 60 and rapidly increasing. It is predicted that the Thai population will exceed 20% by 2025. Furthermore, falls in the older adults are becoming a significant public health concern resulting in injuries, disability and mortality. (Jitapunkul *et al.*, 1994; Jitapunkul *et al.*, 1998). Globally, the number of deaths related to falls was as high as 40,000 in 2022. (WHO, 2012; 2021). The prevalence of falls in the past 6 months was reported at 18.5%. The incidence of falls increases in middle aged persons and peaks at those aged over 80 years. (Rao, 2005). With females having a 1.5 times higher rate of falls compared to males. Injuries that can happen following falls range from milder issues such as bruises, cuts and fractures to more severe conditions that can result in death. (Epidemiology Bureau, 2014). The severity of falls is associated with increased age. (O'Loughlin *et al.*, 1993). The costs related to the management of complications as a result of falls has significantly increased globally, negatively impacting families, communities and societies directly and indirectly. (WHO, 2007).

Falls in the older adults are caused by various degenerations of the body system, for instance, balance, vision, joints, muscles, bones and cognitive functioning or other conditions that induce weakness, fatigue, dizziness, vertigo, trembling or loss of consciousness. (Jitapunkul *et al.*, 1998; WHO, 2012; 2021). Polypharmacy in the older adults is another notable problem with increasing age, in addition to the history of falls that greatly increases the risk of further falls. (Neyens *et al.*, 2006). Environmental factors also contribute to the increased risk of falls, from slippery, rough or uneven surfaces, to cluttered areas, edges of carpets and inadequate lighting. (Huang and Acton, 2004).

Previous studies have examined the efficacy of various preventative strategies for falls in the older adults. From multifactorial fall risk management programs ranging from exercise and environmental modification and education programs found that multimodal management strategies. (Jensen *et al.*, 2003; Shaw *et al.*, 2003; Chang *et al.*, 2004; Tinetti *et al.*, 1994). succeeded in the risk management of falls in the older adults. (Fiatarone *et al.*, 1993; Wolfson *et al.*, 1993; Hornbrook *et al.*, 1994; Buchner *et al.*, 1997).

The efficacy data regarding the environmental modification program is conflicting. (Pyonoos *et al.*, 2010). Furthermore, the usefulness of education programs for fall prevention appears to be limited. In the context of Surin hospital it is found that the

majority of falls in the older adults occur at home or in the vicinity of the house. Moreover, there is a possibility that these patients either underreport their previous care experiences or that the care provided was not ongoing. Subsequently, the rationale emerges to provide home visits with a focus on dwelling-adjustment for fall prevention in the older adults. Hence this study is conducted to evaluate the efficacy of such an intervention in comparison to the standard treatment which does not offer home visits.

Materials and Methods

A prospective randomized controlled interventional study was conducted on older adults aged above 70 years living in Surin province during the 1st of January to 30th of June 2021.

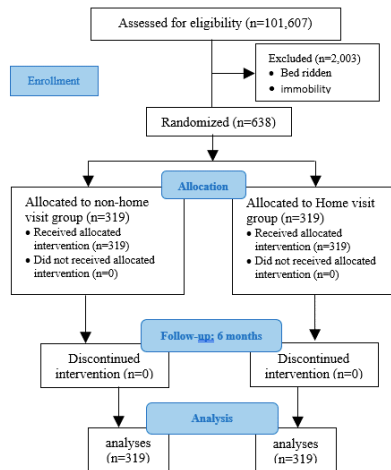
The sample size for our study was estimated based on a pilot study, assuming an 18%¹ prevalence of falls among patients aged over 70 years, with an expectation that dwelling-adjustment home visits could reduce this rate to 10%.

Additionally, the sample size estimation assumed a two-sided test accepting statistical significance at a p-value of <0.05, a power of 0.80 and a 1 to 1 ratio for the study groups. The authors estimated that 319 patients are required per group to conduct the study. Older adults in Surin province aged ≥ 70 were randomly sampled. Forty patients from each of the 17 districts were chosen by a designated researcher initially numbering 680 participants, of which 42 declined to participate, arriving at a total of 638 participants.

The participants were centrally randomized into intervention and control groups using computer-generated random numbers.

A computerized random number generator is used to create a sequence that assigns participants to either the intervention or control group, with no predictability to prevent selection bias. The intervention group received two home visits that carried out dwelling adjustment protocols, two months apart. Each home visit lasted approximately 60 minutes. While the control group received the usual care for a home visit including standard health and social assessments and interventions without a check-list based environmental falls risk assessment.

The nurse and physiotherapist's home visit comprises of a structured assessment focused on barriers to mobility, fall risk, and home safety. The assessment tools used are validated tests and



Figures 1. Shows CONSORT flow chart

measurements such as barriers of mobility, FROP-Com screen (Falls Risk for Older People in the Community) Russell *et al.* (2009) and home safety assessment. The home assessment checklist was adapted from Check for Safety: A Home Fall Prevention Checklist for Older Adults, disseminated by the Centers for Disease Control and Prevention (CDC) (Centers for Disease Control, 2005), in addition to dwelling adjustment protocols for older adults released by the Bureau of Environmental Health, Ministry of Public Health of Thailand. (Bureau of Environmental Health, 2015).

The interventions for dwelling adjustment protocols include the modification of where mobility assisting tools and furniture are placed within the home to cause as little disruption to walking spaces within. Avoidance of placing objects near stairs and the installation of stable

railings and handlebars. In cases of slippery floor surfaces, modifications are made to make floors more rough and without floor patterns to make them less visually confusing. Furthermore, the color of carpets and wall surfaces should be clearly distinguishable from one another. In cases of differences in floor elevation visually clear signs warning residents to avoid the area should be made available. Additionally, the edges of carpets which cause walking surface irregularities should be stuck down with tape. Regarding bathrooms, wet and dry floor surfaces should be clearly separated in addition to the installation of handrails and adequate lighting.

Data for age, gender, comorbidities, BMI, alcohol consumption, activities of daily living, number of falls per six months and baseline fall risk score. The data is presented in risk ratio, risk difference (%), p-value and numbers needed to treat. Figure 1.

Results

Six-hundred and thirty-eight patients aged above 70 in Surin province were included in this study. These patients were divided into two equal groups of 319 between the interventional and control groups.

The proportion of males and females are similar, with the mean age being 79 years, and the interventional group is found to have more comorbidities. Both groups had more than a fall risk scale of less than four. Patients in the control group were more often categorized as partially house bound than those in the interventional group (Table 1).

Tables 1 Shows patient characteristics of both groups

Patient characteristics	Home visit (n=319)		Non-Home visit (n=319)		p-value
	n	%	n	%	
Gender					
Male	161	50.5	155	48.6	0.692
Female	158	49.5	164	51.4	
Age (years), mean ($\pm$ SD)	79.2	($\pm$ 7.8)	78.7	($\pm$ 6.5)	0.347
Presence of Comorbidities					
No	262	82.1	239	75.0	0.034
Yes	57	17.9	80	25.0	
Diabetes mellitus	12	3.7	25	7.8	
Hypertension	15	4.7	15	4.7	
Stroke/Cerebrovascular accident	7	2.2	3	0.9	
Osteoarthritis of the knees	7	2.2	16	5.0	
Blurry vision	16	5.0	21	6.6	
Fall Risk score					
Low (< 4 points)	252	79.0	256	80.2	0.768
High ($\geq$ 4 points)	67	21	63	19.75	
BMI, mean ($\pm$ SD)	22.2	($\pm$ 3.0)	22.6	($\pm$ 3.3)	0.206
Alcohol consumption					
No	313	98.1	315	98.8	0.752
Yes	6	1.9	4	1.3	
ADL					
Partially dependent ($\geq$ 12 points)	144	45.1	134	42.0	0.472
Totally dependent (5-11 points)	175	54.9	185	58	

Tables 2 Shows outcome of the study

Patient characteristics	Home visit (n=319)		Non-Home visit (n=319)		p-value
	n	%	n	%	
No Falls	301	94.4	257	80.6	<0.001
Falls	18	5.6	62	19.4	

The follow up time for patients in this study is six months. There were no cases that were lost during follow up. Patients were also followed up by telephone for any events of falls, which is defined by an unintentional change of body position onto the floor or into a lying position onto the floor.

Eighteen patients in the intervention group were found to have experienced falls (5.6%), while 62 patients in the control group experienced falls (19.4%) (Table 2).

The risk ratio of patients who had falls in the intervention compared to the control group is 0.29 (0.18-0.48)($p<0.001$). The risk difference (%) of patients who had falls in the intervention compared to the control group is 13.8 (-18.8, -8.8)($p<0.001$). When expressed as numbers needed to treat, home visits to eight patients may be required to prevent falls in one patient (95%CI= 6-12 patients).

Using logistic regression to adjust for potential confounders, The adjusted odds ratio was 0.24(0.14-0.42)($p<0.001$). The risk difference was -13.96%, The number needed to treat (NNT) to prevent one additional fall was approximately 7 (95%CI= 6-10 patients). Home visits with a dwelling adjustment-based protocol is effective in reducing the rate of falls in the older adults by 13.96 (-16.25, -10.17)($p<0.001$).

Discussion

Our randomized controlled trial has demonstrated that home visits with a dwelling adjustment protocol significantly reduce the risk of falls among older adults. The adjusted odds ratio of 0.24 (95% CI: 0.14-0.42, $p<0.001$) underscores a substantial decrease in fall risk compared to controls. These results are further supported by the risk ratio of 0.29 (95% CI: 0.18-0.48, $p<0.001$), indicating a robust effect of the intervention. The risk difference of -13.96% (95% CI: -16.25, -10.17, $p<0.001$) highlights the practical significance of the intervention. Approximately 7 individuals (95% CI: 6-10) would need to be treated to prevent one fall. This finding aligns with our initial unadjusted estimates and confirms the efficiency of the intervention even after adjusting for potential confounders.

This method of intervention used consists of a risk assessment performed by a primary care nurse

and physiotherapist of the interior and exterior environment of the patient's home with regards to falls, for example, the detection of slippery floor surfaces, uneven ground, dim-light areas, absent or unstable handrails, narrow corridors inadequate for walking frames, walkways cluttered with obstacles, thick edged carpets and presence of pets etc. This is followed by a modification of the patient's home such as repositioning of furniture and application of bright colored stickers to mark uneven surfaces in addition to providing advice for further preventative strategies to the patient and their family members. The consequence of home assessments and dwelling-adjustments resulting in systematic modifications to patients homes, in addition to identifying and alerting high risk areas and activities to patients and their carers is a reduction in the risk of falls in accordance to previous studies with similar interventions. (Cumming *et al.*, 1999).

In a randomized controlled trial, Close *et al.* (1999) reported significantly fewer falls and recurrent falls in the home assessed group that included provision of educational materials about home safety and appropriate home modifications when compared with the control group.

Integrated risk-management programs that emphasize multiple interventions, including professional assessment, education, and implementation of home modifications, have been shown to be most effective for improving function and reducing falls among older adults. (Close *et al.*, 1999; Day *et al.*, 2002; Gillespie *et al.*, 2003)

Previous studies have examined the efficacy of dwelling-adjustment with conflicting results, for instance, one study reported no significant association between the presence of factors contributing to fall-risk and the actual rate of falls occurring in those homes. (Gill *et al.*, 2000). While another randomized-controlled study found that dwelling-adjustment was effective at preventing further incidents in patients already suffering from recurrent falls. (Lord *et al.*, 2006). Furthermore, another study reported that an occupational therapist-led risk assessment for falls and dwelling-adjustment can reduce the rate of falls. (Cumming *et al.*, 1999). One possible explanation for such conflicting results in literature may be due to the variation in assessment and dwelling-adjustment protocols between the studies in addition to the differing factors of each individual patient which

contributes to the risk of falls such as the home environment, physical fitness, use of mobility assisting tools and the presence of caregivers.

Conclusions

Home assessment and environmental modification play an important role in reducing the risk of falls and helping older adults individuals remain carrying out their daily lives safely within their communities. This approach advocates for a paradigm shift in clinical practice and public health policy towards proactive, environment-focused preventive strategies. It highlights the necessity for healthcare systems to integrate environmental assessments into standard care routines and for policymakers to allocate resources and support towards implementing preventive home adjustments, aiming to bolster safety and autonomy for older adults individuals within their communities.

Study Limitations

The sample size is confined to Surin province, which may limit the generalizability of the findings to other regions or populations with different demographic characteristics. Secondly, the reliance on self-reported incidents of falls may introduce reporting bias, potentially underestimating the true incidence of falls. Additionally, the intervention's effectiveness could be influenced by the variability in the execution of home adjustments, depending on the individual's home environment and adherence to recommendations.

Implications of the Study

This study underscores the importance of preventive, home-based interventions in reducing fall risks among the older adults, with significant implications for both clinical practice and public health policy. It suggests that healthcare providers should consider incorporating home visits and dwelling adjustments into routine care for older adults patients. Furthermore, the findings highlight the need for policy reforms to support the implementation of such interventions, potentially involving adjustments in healthcare funding, training for healthcare professionals in fall prevention strategies, and public awareness campaigns to educate on the importance of home safety in preventing falls. These actions could collectively enhance the quality of life for older adults and reduce the healthcare system's burden.

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