

Reducing Falls among Asian Community-dwelling Older People through Fall Prevention Programs: An Integrative Review

Hai Mai Ba, Katre Maasalu, Binh Duy Ho*

Abstract: Falls among community-dwelling older people is a serious concern globally since they are recognized as a major cause of mortality and an increasing illness burden. This integrative review aimed to gain insight to the characteristics and effectiveness of fall prevention interventions among Asian community-dwelling older people. MEDLINE, CINAHL, Web of Sciences, and Embase databases were used to search for articles published between 2006 and 2020. The research was carried out in English or Vietnamese and combined the following inclusion criteria: fall prevention intervention, community-dwelling elderly, and results concerning fall-related outcomes.

Thirteen studies from China, Thailand, Japan, and Iran met the inclusion criteria and were included in the study. The characteristics of fall prevention interventions were categorized into five main components: fall risk assessment, medication management, physical exercise, environmental modification, and health education. Overall, the effectiveness of fall prevention intervention significantly reduced fall rates and fall-related outcomes for community-dwelling older people in Asian countries. However, there were differences in intervention types, outcome measures, and time frames. This review emphasizes the importance of combined exercise intervention as an essential component in strengthening motor skills, balancing ability, and increasing physical condition. Future study should be conducted in big databases to avoid missing important studies, and additional research from Asia is essential to prepare for future challenges of reducing falls among the elderly in this area.

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Introduction

Falls among community-dwelling older people are a serious concern globally since they are recognized as a major cause of mortality and an increasing illness burden.¹ According to WHO (2021) data, falls are the second largest cause of unintentional injury deaths globally. Adults over the age of 60 suffer the highest number of falls or serious injuries, and the incidence of falls is found to increase with age,² with at least 20%

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of older adults aged 65 and over falling in a year.³ In the Asia region, the fall rate was reported around 10.4% to 53.6% of older people living the community.⁴ In Vietnam, falls with older people have also been

researched in a number of studies.^{5, 6} It estimated that the incidence of falls among older people was around 30–40%.⁷ The most common causes of falls occur at home, caused by dizziness while standing up, a slippery floor, and a loss of balance. The use of psychiatric drugs, having three or more comorbidities, hypertension, COPD, urine incontinence, frailty, fear of falling, ADL/IADL limitation, slow walking speed, and mobility impairment were all significantly linked with falls.⁵

Recently, there are many effective fall prevention interventions that have been studied and reviewed.⁸⁻¹¹ Most previous studies were conducted in developed countries such as in the US, Europe, and Australia, where living conditions and human factors are different from those in Asia and Southeast Asia.^{8,12} These interventions are usually based on modifiable risk factors for falling, such as exercise, medication review, dietary supplements, environmental modifications, and behavioral therapy.¹³ These can be performed alone or in combination with or without a customized intervention based on patient assessment.^{3,13} Intervention effectiveness has also been demonstrated in many previous studies that decrease fall occurrence and fall-related factors.^{12,14} According to NICE guidelines for fall prevention, the following specific components are important in successful multifactorial intervention programs: exercises, home hazard assessment and interventions, vision evaluation, and medication review.⁹ However, the application of these interventions in any given country may depend on differences in risk factors for falls, such as diet, exercise patterns and preferences,¹⁵ knowledge and attitudes towards ageing and fall prevention,¹⁶ and the home and outdoor environment and footwear.^{4,12} Additionally, differences in health services and systems may influence engagement of older people in these interventions.¹⁷ There have been three review studies completed in the Asia region, however, two studies largely focused on the epidemiology of falls among older people and made no recommendations for unique interventions to reduce falls in this region's older people.^{4,18} The other systematic review suggested that Tai Chi was the common exercise that was effective in preventing falls in community-based older people.

However, substantial investment is required in large, properly powered randomized controlled trials testing falls prevention programs across Asia, particularly those that integrate intervention techniques tailored to the local Asian environment.¹²

Therefore, we conducted this review to investigate the fall prevention interventions conducted among older people living in communities across the Asian region, with the aim of (1) identifying the characteristics of fall prevention interventions, (2) examining their effectiveness on fall outcomes and fall-related outcomes. Further, the findings of this study suggest appropriate fall prevention interventions for older people in Asian communities.

Methods

This study was an integrative review (IR) using the Whittemore and Knafl's IR Framework¹⁹ which was accepted for the inclusion of all study designs.

Inclusion criteria: Articles were selected based on the PICO model²⁰: (1) the target population was older people living in communities in Asian countries; (2) the types of interventions described in terms of a single intervention (SI) comprising only one major category of intervention such as exercise, home modification, medication management, nutrition, and regular health checking; a multifactorial intervention (MI) referring to more than one primary type of intervention that is personalized to the individual based on their risk of falling; multiple component interventions (MCI) consisting of a fixed combination of two or more major categories of intervention;³ (3) a comparison group was a control group or one group with pre- and post-test; (4) outcomes included fall outcomes (number of falls, number of fallers, fall rate) and fall-related outcomes (balance ability, muscular strength, gait speed, and psychological conditions).

Search strategies: MEDLINE, CINAHL, Web of Science, and Embase databases were searched for related publications. The following MeSh subject terms and keywords were used: 'fall prevention,' 'accidental falls,' 'exercise,' 'aged,' 'older people,' 'elderly,' 'community.' The searches were limited to the papers

that were accessible for review, written in English or Vietnamese, and published between January 2006 and December 2020.

Study Selection and Quality: One investigator read over the titles and abstracts of all articles found through database searches to select potential articles for review. Next, according to the inclusion or exclusion criteria, two investigators independently evaluated the obtained full-text studies. Studies that did not meet the inclusion criteria were excluded, and selected articles were agreed upon by two investigators and evaluated for quality in the following phase. The quality of selected articles was appraised using the Mixed Methods Assessment Tool (MMAT; version 2018). Each article was independently scored by the two investigators as yes, no, or cannot tell for each item. Any difference in the score of each item was subsequently discussed and resolved by the two investigators. Excluding articles with low methodological quality was discouraged.

Data Extraction and Synthesis: A data extraction sheet was designed to organize the necessary information for each study, such as authors (published years), country, study design, sample (size, age, gender), intervention characteristics, and major findings/outcomes (fall outcomes and fall-related outcomes).

Results

Characteristics of included studies and fall prevention intervention: The search process identified 1269 articles for potential inclusion in the review. After screening the articles for titles and duplication, 1097 articles were removed; and 65 articles were excluded for abstract review. The remaining 107 articles were obtained for full-text reading, which resulted in 94 articles being excluded for various reasons. Finally, 13 studies were selected that satisfied the inclusive criteria (see **Figure 1**).

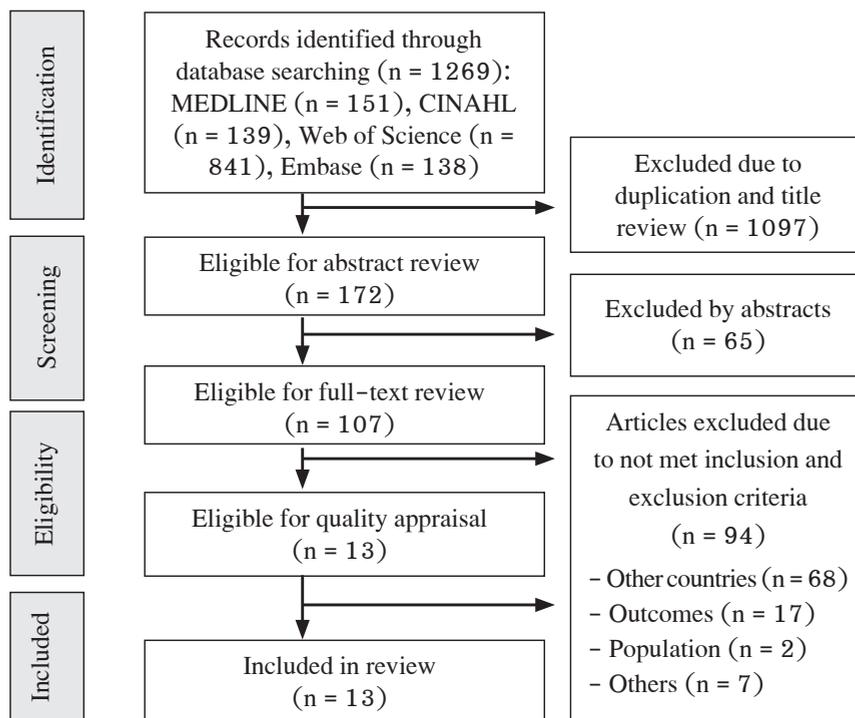


Figure 1. Process of inclusion and exclusion of studies used in this integrative review

The features of the 13 included studies are summarized in **Table 1**, five of which were conducted in China,²¹⁻²⁵ four in Japan,²⁶⁻²⁹ two in Thailand^{30,31} and two in Iran.^{32,33} Regarding research design, there were five RCT studies,^{24,26,27,31,33} five quasi-experimental studies,^{21,23,29,30,32} and three prospective cohort studies.^{25,28,34}

The classification of fall prevention interventions of 13 studies is shown in **Table 2**. There were five main components of the fall prevention interventions, including fall risk assessment, medication management, balance and mobility, environmental modification, and health education. Of these, physical exercise was commonly implemented in 11 studies,^{21,24,25-32,34} health education was an element of the fall prevention program in 10 studies,^{21,23,26-32,34} five studies considered home modification^{23,30-32,34} and five studies assessed fall risks before implementing the intervention, including fall evaluation,³⁴ hazard assessment,²³ multifactor fall risk assessment,^{28,30} physical and mental assessment, and blood pressure checking.²⁷ Medical management or home visits were implemented in just three studies.^{28,30,34} The following are the specific of these five components:

Fall risk assessment. Individuals and environmental risk factors were identified as fall risk assessment components in this analysis. The individual fall risk assessments comprised basic health measures such as medical history, visual, neurologic, cardiovascular,^{27,28,34} cognitive and psychological measures,²⁸ and physical measures (muscle strength and balance ability).^{27,28,34} On the other hand, environmental hazard assessment consisted of floor lighting, slippery floor surfaces, objects in the walkway, unstable furniture, loose rugs, shelves or cupboards too high or too low, lack of safety rails in the toilet, and bathroom, stairs too steep.²³ In addition, according to Kittipimpanon et al., the multifactor risk assessment regarding fall risk factors among older people in the community was indicated to access fall risk factors.³⁰

Medication management. This fall prevention component was conducted during the training session³⁴

or during home visits.^{28,30} Medication management was usually focused on medication review and education on possible side effects of the interaction of multiple drugs. This intervention was often done every 3 months²⁸ or twice yearly.³⁰

Physical exercise. The exercise programs were implemented in individuals^{27,34} or groups.^{21,25,29,30,34} The stretching exercise, progressive muscle strengthening, and balance training were the most common training. The duration of the exercise program lasted at least 45 minutes to 2 hours per session, 1 to 5 days per week, and from 4 weeks to 1 year. One study by Leung et al. used low-magnitude high-frequency vibration to prevent falls and enhance muscle performance in the elderly. This program was conducted 5 days per week for 18 months by the individual at the community center.²⁴ Another study used Chen-style Tai Chi with 13 movements at public places for exercise by an instructor.

Environmental modification. In this review, the environmental modification was implemented by assessing home hazards^{31,34} and community hazards^{23,30} and provided intervention programs including education, home modification,²³ and the provision of aids and gadgets such as an installed handrail in the bathroom or toilet or a walking-assistive device.^{31,34}

Health education. The topic of health education varied, but the majority of this was focused on fall risk factors^{23,27,30-32} and prevention strategies, including food and nutrition,^{27,28} fall prevention behaviors,^{23,30} yearly vision screening,³⁰ medication use and side effects,^{30,32,34} balance/exercise strategies^{21,23,30,32} and environment management.^{21,26-28,30} A variety of teaching methods were used, including lectures,^{28,32} discussion and sharing of experiences,³⁰ healthcare consultation,^{23,27,29,34} distribution of printed fall prevention strategy material,^{23,30-32} and hanging posters.^{21,23,30}

Table 1. Descriptive summary of fall prevention intervention for Asian community-dwelling older people

Authors (year) country	Study design Sample size (each group) Participants	Objectives	Fall prevention intervention	Major outcomes
Lin et al. ²¹ China	<ul style="list-style-type: none"> Experimental study n = 1200 (IG, n = 472, CG, n = 728) Community-dwelling elderly, age < 70 yrs (48.9%), <75 yrs (33%), >75 yrs (18.2%), female 68.2% 	To study the effect of a community-based Tai Chi program on injurious falls, balance, gait, and fear of falling among Taiwanese people aged 65 and older	<ul style="list-style-type: none"> Intervention: Community-Based Tai Chi Type: MCI Interventioner: Instructor Place: Community Duration: 1 yr Follow-up: 1 & 2 yrs Adherence rate: 76.5% 	<ul style="list-style-type: none"> Fall outcomes 1. Injurious falls (-) Fall-related outcomes 1. Tinetti Balance Scale score (+) between group. 2. Tinetti Gait Scale score (+) between group. 3. Fear of falling (-) between group
Inokuchi et al. ²⁶ Japan	<ul style="list-style-type: none"> Controlled intervention trial n = 166 (IG, n = 144, CG, n = 124) Community-dwelling elderly, age IG: 80.2 yrs, CG: 81.4 yrs, females IG: 85.1%, CG: 83.1 % 	To examine the effect of exercise program in improving physical function and psychological status, and reducing falls and risk factors for falls in elderly people	<ul style="list-style-type: none"> Intervention: Nurse-led community exercise program Type: MCI Interventioner: Public health nurses Place: Community Duration: 17 weeks Follow-up: 17 weeks Adherence rate: 90.9% 	<ul style="list-style-type: none"> Fall outcomes: 1. Incidence of further falls (+) 2. The number of risk factors (+) Patients' related outcomes: 1. Psychological status within IG (+) 2. Physical function between group, and within IG (+)
Size et al. ³⁴ China	<ul style="list-style-type: none"> Prospective cohort n = 60 Community-dwelling elderly, age 74.96 yrs, females 92.6% 	To investigate the efficacy of a fall prevention clinic and a community step-down program in reducing the number of falls among community-dwelling elderly	<ul style="list-style-type: none"> Intervention: Multidisciplinary Falls Prevention Type: MI; Interventioner: Multidiscipline Place: Community Duration: 3 months Follow-up: 9 months Adherence rate: 80% 	<ul style="list-style-type: none"> Fall outcomes 1. Fall rate (+) 2. Injurious falls (+) 3. Fall-associated medical consultation (+) Patients' related outcomes: 1. Balance scores (+)
Xia et al. ²³ China	<ul style="list-style-type: none"> Quasi-experimental study n = 2310 (IG, n = 1316, CG, n = 944) Community-dwelling elderly, age 72.05 yrs, females 52.3% 	To evaluate the effect of the multifaceted intervention in reducing the incidence of falls in community-living older adults in China	<ul style="list-style-type: none"> Intervention: Community-based multifaceted fall-prevention intervention Type: MCI Interventioner: Local centre for disease control and prevention Place: Community Duration: 18 months Follow-up: 18 months Adherence rate: 54.9% 	<ul style="list-style-type: none"> Fall outcomes 1. The annual fall rate (+) 2. Fall-related injury (+) 3. Fall-related fracture (+) Fall-related outcomes 1. Fall-related knowledge (+), attitudes (+) and practices (-)

Table 1. Descriptive summary of fall prevention intervention for Asian community-dwelling older people (Cont.)

Authors (year) country	Study design Sample size (each group) Participants	Objectives	Fall prevention intervention	Major outcomes
Kittipimpanon et al. ³⁰ Thailand	<ul style="list-style-type: none"> Quasi-experimental study n = 41 Community-dwelling elderly, age 72.93 yrs, females 75.6% 	To examine the effectiveness of community-based fall prevention program for elderly Thais	<ul style="list-style-type: none"> Intervention: The Community-based Fall Prevention Program Type: MI Interventioner: Public health volunteers; the elder club president; public health nurse; and community leaders. Place: Community Duration: 12 weeks Follow-up: 10 months Adherence rate: 89.52% 	<ul style="list-style-type: none"> Fall outcomes 1. Fall incidence (+) Fall-related outcomes 1. Fall prevention behaviors (+) 2. Physical performance (+) 3. Satisfaction with the fall prevention program (+)
Leung et al. ²⁴ China	<ul style="list-style-type: none"> Cluster-RCT n = 710 (IG, n = 364, CG, n = 346) Community-dwelling elderly, age 73 yrs, females 100% 	To study the effect of low-magnitude high-frequency vibration (LMHFV) in reducing fall and fractures among the elderly in the community	<ul style="list-style-type: none"> Intervention: Low-magnitude high-frequency vibration Type: SI Interventioner: Research staff Place: Community Duration: 18 months Follow-up: 9 and 18 months Adherence rate: 66% 	<ul style="list-style-type: none"> Fall outcomes 1. Fall rate (+); 2. Fracture rate (-) Fall-related outcomes 1. Balance ability (+) 2. The quadriceps muscle strength (+) 3. Bone mineral density (-) 4. Quality of life (-)
Kamei et al. ²⁷ Japan	<ul style="list-style-type: none"> RCT n = 130 (IG: 67, CG: 63). Community-dwelling elderly, age 75 yrs, females 83.6% 	To evaluate HHMP in improving fall prevention awareness and home modification behaviors and reducing indoor falls among community-dwelling older persons over a one-year period	<ul style="list-style-type: none"> Intervention: Home hazard modification education program Type: MI Interventioner: Nurse, physician, nutritionist Place: Urban community Duration: 4 weeks Follow-up: 12 and 52 weeks Adherence rate: 83.6% 	<ul style="list-style-type: none"> Fall outcomes 1. Falls and falls indoors (+) at 52 weeks 2. Falls and indoor falls at 12 weeks for older >75 years (+) Fall-related outcomes 1. Home fall prevention awareness # (+) 2. Home modifications (+)

Table 1. Descriptive summary of fall prevention intervention for Asian community-dwelling older people (Cont.)

Authors (year) country	Study design Sample size (each group) Participants	Objectives	Fall prevention intervention	Major outcomes
Yeung et al. ²⁵ Hong Kong	<ul style="list-style-type: none"> • Cohort study • n = 99 (IG = 48, CG = 51). • Community-dwelling elderly, age IG: 73.94, CG: 76.80, females IG 72.9%, CG: 88.2% 	To evaluate the effectiveness of a fall prevention program in a group of community-dwelling older adults with risk of falling	<ul style="list-style-type: none"> • Intervention: group-based falls prevention exercise program • Type: SI; • Interventioner: exercises instructors • Place: the integrated primary health and social care centre • Duration: 36 weeks • Follow-up: 12, 24 and 36 weeks • Adherence rate: 79.0% • Intervention: Otago Exercise Program • Type: SI • Interventioner: GP, nurse, public health • Place: Home • Duration: 6 months • Follow-up: 6 months • Adherence rate: 58.3% • Intervention: Year-round program • Type: MI • Interventioner: Multidisciplinary team • Place: Community salons • Duration: 12 months • Follow-up: 12 months • Adherence rate: 81.6% 	<p>Fall outcomes</p> <ol style="list-style-type: none"> 1) Number of falls (-) 2) Number of falls requiring medical attention (-) 3) The percentage of fallers (-) 4) Number of recurrent fallers (-) <p>Fall-related outcomes</p> <ol style="list-style-type: none"> 1) Balance (+); 2) Physical activities (+); 3) Fear of falling (+) <ul style="list-style-type: none"> • Fall outcomes <ol style="list-style-type: none"> 1. The incidence of falls (+) • Fall-related outcomes <ol style="list-style-type: none"> 1. Physical performance (+) 2. Functional capacity (+)
Dadgari et al. ³³ Iran	<ul style="list-style-type: none"> • RCT • n = 317 (IG = 160, CG = 157) • Community-dwelling elderly, age 70.60 yrs, females no reported 	To examine the effectiveness of OEP to reduce falls among elderly people in Iran	<ul style="list-style-type: none"> • Intervention: GP, nurse, public health • Place: Home • Duration: 6 months • Follow-up: 6 months • Adherence rate: 58.3% • Intervention: Year-round program • Type: MI • Interventioner: Multidisciplinary team • Place: Community salons • Duration: 12 months • Follow-up: 12 months • Adherence rate: 81.6% 	<p>Fall outcomes</p> <ol style="list-style-type: none"> 1. The incidence of falls (+) • Fall-related outcomes <ol style="list-style-type: none"> 1. Physical performance (+) 2. Functional capacity (+)
Otake et al. ²⁸ Japan	<ul style="list-style-type: none"> • The prospective controlled trial • n = 603 (CG = 185, IG = 418) • Community-dwelling elderly, age 73.1 yrs, females 83.3% 	To identify an effect community-based fall prevention program	<ul style="list-style-type: none"> • Intervention: Year-round program • Type: MI • Interventioner: Multidisciplinary team • Place: Community salons • Duration: 12 months • Follow-up: 12 months • Adherence rate: 81.6% 	<p>Fall outcomes</p> <ol style="list-style-type: none"> 1. Fall rate between group (-) 2. Fall rate within group (+) <ul style="list-style-type: none"> • Fall-related outcomes (within group) <ul style="list-style-type: none"> - Physical and psychological indices (-)

Table 1. Descriptive summary of fall prevention intervention for Asian community-dwelling older people (Cont.)

Authors (year) country	Study design Sample size (each group) Participants	Objectives	Fall prevention intervention	Major outcomes
Ueda et al. ²⁶ Japan	<ul style="list-style-type: none"> • RCT • n = 60 (IG = 30, CG = 30) • Community-dwelling elderly, age 75.0, females 67% 	To examine the effect of an education program on falls prevention in discharged older patients	<ul style="list-style-type: none"> • Intervention: The tailored education program using home floor plans • Type: MCI • Interventioner: Physical therapist • Place: Home • Duration: 1 month • Follow-up: 1 month • Adherence rate: 85% 	<ul style="list-style-type: none"> • Fall outcomes 1. Faller (IG:0, CG:2) 2. Near-falls (+)
Suttanon et al. ³¹ Thailand	<ul style="list-style-type: none"> • RCT • n = 277 (IG = 131, CG = 146) • Community-dwelling elderly, age 72 yrs, females 74.04% 	To evaluate the effectiveness of a fall prevention intervention program for older people in Thailand	<ul style="list-style-type: none"> • Intervention: Falls prevention program • Type: MCI • Interventioner: Physiotherapist • Place: Community • Duration: 4 months • Follow-up: 4 months • Adherence rate: 90% 	<ul style="list-style-type: none"> • Fall outcomes 1. Faller (-) 2. Number of falls in the previous year (-) • Fall-related outcomes 1. Balance: small change. 2. Safety (+)
Najafi-Ghezeljeh et al. ³² Iran	<ul style="list-style-type: none"> • Quasi-experimental study • n = 160 (only IG) • Older people in nursing home, age 67.63 yrs, females 81.2% 	To study the effects of a multicomponent fall prevention intervention in reducing fall incidence, depression, and balance among nursing home residents	<ul style="list-style-type: none"> • Intervention: Multicomponent fall prevention interventions • Type: MCI • Interventioner: Physical therapist • Place: Nursing home • Duration: 4 months • Follow-up: 6 months • Adherence rate: 100% 	<ul style="list-style-type: none"> • Fall outcomes 1. Fall frequency (+) • Fall-related outcomes 1. Mobility (+) 2. Balance (+) 3. Depression (+)

IG: intervention group, CG: control group; yrs: years; wks: weeks; mths: months; n: sample size; SI: single interventions; MI: multifactorial interventions, MCI: multiple component interventions; RCT: randomized controlled trial; (+): Significant, (-): Non-significant; Home Hazard Modification Program: HHMP

Table 2. Types of fall prevention intervention for Asian community-dwelling older people

Authors/ Published year	Risk Assessment	Medication Management	Balance & Mobility	Environmental Modification	Education
Lin et al. ²¹			<ul style="list-style-type: none"> Tai chi 		<ul style="list-style-type: none"> Posters (exercises, use of walking aids, environmental improvements)
Inokuchi et al. ²⁹			<ul style="list-style-type: none"> Exercise 		<ul style="list-style-type: none"> Educational program about falls
Sze et al. ³⁴	<ul style="list-style-type: none"> Fall-risk evaluation 	<ul style="list-style-type: none"> Medical referrals 	<ul style="list-style-type: none"> Balance training Group exercise program Home exercise program 	<ul style="list-style-type: none"> Home hazard management program Home visitations Aids and gadgets provision Hazard elimination 	<ul style="list-style-type: none"> Falls prevention education
Xia et al. ²³	<ul style="list-style-type: none"> Hazard assessment 				<ul style="list-style-type: none"> Education program Brochure distribution Poster exhibition Healthcare consultation
Kittipimpanon et al. ³⁰	<ul style="list-style-type: none"> Multifactor fall risk assessment 	<ul style="list-style-type: none"> Home visit for checking medicine 	<ul style="list-style-type: none"> Balance/exercise 	<ul style="list-style-type: none"> Fall management system 	<ul style="list-style-type: none"> Fall prevention campaign Education program
Leung et al. ²⁴			<ul style="list-style-type: none"> Low magnitude high-frequency vibration 		
Yeung et al. ²⁵			<ul style="list-style-type: none"> Physical exercise 		
Kamei et al. ²⁷	<ul style="list-style-type: none"> Physical and mental assessment Blood pressure check 		<ul style="list-style-type: none"> Exercise 		<ul style="list-style-type: none"> Education regarding fall risk factors, food and nutrition, foot self-care. Education and practice regarding environmental safety
Dadgari et al. ³³			<ul style="list-style-type: none"> Otago exercise program 		
Otake et al. ²⁸	<ul style="list-style-type: none"> Comprehensive fall risk assessment 	<ul style="list-style-type: none"> Home visits 	<ul style="list-style-type: none"> Physical exercises 		<ul style="list-style-type: none"> Fall prevention lecture: Modification of environmental risks <ul style="list-style-type: none"> Nutritional improvements Tailored education program regarding environmental modification
Ueda et al. ²⁶			<ul style="list-style-type: none"> Physical exercise 		
Suttanon et al. ³¹			<ul style="list-style-type: none"> An individualized home-based balance exercise 	<ul style="list-style-type: none"> A handrail (to be installed in the bathroom or toilet) or a walking-assistive device 	<ul style="list-style-type: none"> Exercise booklet Booklet of falls risk management
Najafji-Ghezzeleh et al. ³²			<ul style="list-style-type: none"> Physical exercise 	<ul style="list-style-type: none"> Environmental modification 	<ul style="list-style-type: none"> Fall prevention educations: Fall risk factors, Mobility aids Best stretching, strengthening Balance-improving exercises Other (drug)

The effectiveness of fall prevention interventions

The major effectiveness focused on two main outcomes, fall outcomes and fall-related outcomes:

Fall outcomes. The effectiveness of a fall prevention intervention on fall outcomes was classified into three common indicators: the number of falls, the fall rate, and the number of fallers.³⁵ Out of the 13 included studies, 11 reported the number of falls as an endpoint of the effectiveness of the intervention, including fall incidence,^{25,27,29,30,33} fall-related injury or fall-related fracture,^{23,24,34} fall-associated medical consultation,^{25,34} fall frequency,³² and near-fall.²⁶ The fall rate was reported in four studies,^{23,24,28,34} and the number of fallers was reported in three studies.^{25,26,31}

Overall, the effectiveness of the intervention on the number of falls was significantly improved in included studies. However, there were differences in intervention types, outcome measures, and time frames. The participants in the multifaceted fall prevention intervention group showed a significant reduction in the number of falls from 10.67% to 24.86% compared with the control group.^{23,27,30} In another study, the single intervention of the Otago Exercise Program resulted in a reduction in the incidence of falls after 6 months of follow-up when compared to the control group ($\chi^2 = 21.19$, $df = 3$, $p < 0.001$).³³ Najafi-Ghezalje et al. found that a multicomponent fall prevention intervention reduced fall frequency significantly after 6 months ($p < 0.001$).³² Nevertheless, one study showed no statistically significant difference in the number of falls and the number of falls requiring medical treatment between the single exercise intervention and comparison groups.²⁵ Furthermore, two studies reporting fall-related injury outcomes found positive effects for fall-related injury and fracture outcomes in the intervention group compared to the control group after 18 months^{23,24} and one prospective cohort study found that fall prevention clinic programs were effective in reducing injurious falls (43% after 9 months of follow up).³⁴

Fall rates were reported in four studies, with three demonstrating a significant decrease in fall rates following the intervention. One study indicated that the yearly fall rate in the participants with multifactorial intervention (MI) decreased by 10.52%, but the difference was not statistically significant in control participants.²³ Another study found that the fall rate decreased by 74% compared to before intervention within MI participants.³⁴ According to Leung et al., the vibration group had a 46% decreased fall incidence rate when compared to the control group.²⁴ However, fall rates among older people in the study of Otaka et al. did not significantly reduce between programs ($p = 0.449$), and there was no significant difference in these rates between primary programs following modification.²⁸

Finally, the effectiveness of the intervention on the number of fallers was not statistically different in intervention participants compared to the control group in three trials.^{25,26,31}

Falls-related outcomes. Balance ability was identified as one of the most important hazards of falls in nine studies,^{21,24,25,29-34} followed by muscle strength,^{24,29,30,33} psychological status,^{21,25,29,32} gait condition,^{21,25,29} and functional mobility.^{25,32} Other fall-related outcomes were also documented in several studies, including three studies that assessed the falls prevention awareness and behaviors,^{23,27,30} followed by quality of life,²⁴ intervention safety,³¹ satisfaction with the fall prevention program,³⁰ and home modification.²⁷

The effectiveness of the intervention on balance had positive findings in nine out of 13 studies, with intervention durations ranging from four to 24 months. The time up and go (TUG) test was utilized in five studies, three of which found that TUG improved substantially in the intervention group compared to the control group. However, there are differences in the type of intervention and the duration of the intervention, such as a nurse-led community exercise program in 17 weeks,²⁹ Otago exercise program over six months,³³

and the community-based falls management exercise program over 36 weeks.²⁵ In addition, two other studies found that TUG improved after the intervention compared to before the intervention.^{30,32} The four additional studies examined balance skills using the Berg-Balance-Score, Tinetti Balance Scale Score, and other tests, and all indicated good results in intervention participants.^{21,24,25,34}

The effectiveness of the intervention resulted in significantly increased muscle strength in four of 13 studies, including quadriceps muscle strength,²⁴ upper extremity strength ($p < 0.01$) and lower-extremity strength ($p < 0.001$),³³ lower body strength ($p < 0.001$),³⁰ and the study of Inokuchi et al. found an significant improvement in lower extremity strength ($p = 0.028$) and but no significant change for upper extremity strength ($p > 0.05$).²⁹

In terms of gait speed results, two studies revealed that intervention group participants had a significantly higher gait test score than control participants. Lin et al. found that Tai Chi practitioners improved their Tinetti Gait Scale scores by 0.9 points (95%CI = 0.1–1.8) when compared to the control villagers.²¹ Another study found that the exercise intervention group demonstrated significant functional improvements in the 5-metre walk test ($p = 0.003$) after 17 weeks of the intervention, with no significant difference in the control group and between groups ($p = 0.270$).²⁹ In addition, levels of physical activity were also improved after intervention in two other MCI, SI studies.^{25,32}

Furthermore, the effectiveness of fall intervention on psychological status, including fear of falling and depression was also a significant improvement in three out of four studies. According to Inokuchi et al., depression status significantly improved after 17 weeks of intervention in the intervention group compared to the control group ($p < 0.001$).²⁹ Another pre- and post-test study also indicated that depression significantly decreased after six months of intervention, from 10.14 ± 6.85 at pre-test to 8.23 ± 5.17 at post-test ($p < 0.001$).³² For fear of falling, Yeung found that over 36 weeks,

the exercise intervention group participants experienced less than the comparison group and within the intervention group.²⁵ However, Lin et al. found no significant difference between groups in the effect of the intervention on fear of falling after community-based Tai Chi intervention.²¹

Discussion

This was the first integrative review on the effectiveness of fall prevention in the community elderly population in the Asian region. Regarding the nature of this review, we collected a variety of study designs to review various points of information concerning fall prevention in the elderly. In most of the intervention studies we examined, MI and MCI programs were adopted to address the multifactorial aspect of falling in the elderly. These findings are congruent with the fall prevention policies of other countries, which state that falls among older people are a multifaceted problem that requires multifaceted, multi-level, and integrated alternatives.³⁶ This is also consistent with previous studies that concluded that MCI and MI were associated with a lower risk of fall-related outcomes compare with usual care.^{8,13}

Among five major components of fall prevention intervention identified in the included studies, exercise is common interventions that is usually combined in MI and MCI programs. This training lasted 45 minutes to two hours per session and focused on stretching, progressive muscle strengthening, and balancing training, which are usually simple, gentle, and convenient exercises for the elderly that do not require expensive support equipment, such as Tai Chi²¹ and the Otago program^{31,33} In addition, this training was also mostly implemented in groups at public places, as a result, it is appropriate for senior people in Asia, who typically exercise together in public settings in the morning and afternoon. Health education intervention was the second common component that usually addressed fall risk factors topics and fall prevention strategies such as diet and

nutrition, exercise booklet, and environmental safety. This is congruent with the clinical practice guidelines from Singapore, which suggest that by giving basic knowledge on risk factors and the benefits of fall prevention, the elderly may be able to make more informed judgments about participating in falls prevention programs, which may enhance adherence to these interventions.³ In addition, fall risk assessment, medication management, and environment modification were viewed as essential components in fall prevention programs for the elderly in this present analysis. The effectiveness of these interventions was mostly combined with other interventions rather than alone. In particular, the assessment of fall risk factors played an important role in determining the appropriate interventions for each different local environment. Therefore, it is recommended for future studies to use MI in a fall prevention strategy for older people in the community.

The effectiveness of fall prevention interventions was mostly associated with a reduction in fall outcomes and fall-related outcomes among older people living in the community in the current study. Out of 13 studies, nine studies showed significant reductions in fall outcomes, seven studies showed significant improvement in balancing abilities; four studies showed increased muscular strength, four studies showed significant improvement in gait speed and physical activities following fall prevention intervention. Importantly, our review results emphasized that exercise is an important component of most fall prevention interventions in older people, and only two studies implemented exercise as a single intervention. Most studies demonstrated positive outcomes, except for three studies. These results are in line with a previous systematic review demonstrating that exercise was associated with fall-related benefits and fall-related outcomes.^{8, 13} These results suggest encouraging older people to exercise and combining this with other interventions in preventing falls and reducing the risk of falls.

Although the effectiveness of exercise was demonstrated in the studies above, there were still 3

studies that did not have an improvement. One study revealed the Tai Chi program (MCI study) did not significantly reduce the incidence of injurious falls among participants at the individual and community levels. The rationale for this result was explained by an unexpectedly significant reduction in injurious falls in the control group, and an educational program could be beneficial in decreasing falls in a control group.²¹ Another study conducted in Thailand concluded that the MI was ineffective in terms of reducing the incidence of falls, and fallers since fall risk management strategies could not be implemented for all participants and some participants received other support.³¹ The last one was the SI of a group-based exercise program, which demonstrated no significant difference in the number of falls and fallers across groups. The main reason for this is that risk factors for falls, such as medical or environmental risk factors, or involvement in risky behaviors were not identified in the intervention period; and the accuracy of fall detection may differ between groups.

Finally, according to the current review, health education, fall risk assessment, medication review, and environmental modification are all beneficial and may help to reduce falls in community-dwelling older people. However, the number of these interventions is still limited in Asia. Although there was a report related to education about the home environmental modification for discharged patients, it was included in the analysis since the intervention focused on older people living in the community. The results, however, did not show a significant reduction in falls since the follow-up time after the procedure was not long in scope and the trial design was one-blind, which might have caused bias.²⁶ Therefore, more of these interventions among older Asians are needed to further confirm their effectiveness, despite the fact that they have been applied and verified in numerous regions across the globe.³⁷

Therefore, selection of type of fall prevention program to be implemented among Asian community-dwelling older people must be carefully studied.

There is no “one-size-fits-all” strategy for preventing falls. More local risk factors or protective factors for falls should be investigated in future research. In addition, it is suggested that exercise should be combined with a multi-factorial intervention to increase its effectiveness in reducing the fall risks and rate of falls among community-dwelling older people. These programs should be provided by a multidisciplinary team to ensure equitable intervention and management for all participants.

Limitations

This review has several limitations. First, only articles published in English were identified in the current study; although studies in Vietnamese were examined, no results were obtained. Therefore, any other studies published in other languages may have gone undetected. Furthermore, the search database was limited, which meant that all-important research may have been missed. As a result, the number of studies considered in this review is small. Second, the variability of outcome measures and interventions utilized in the research prevented statistical pooling of quantitative data. In addition, this study was originally intended to provide recommendations on fall prevention interventions for the community-dwelling older people in Vietnam, but there were still very few intervention studies related to this issue in this area, as a result, we lack a database to examine the necessary data to make recommendations.

Conclusion

This study provided valued information on published research on the effectiveness of fall prevention interventions among older people in Asian countries. The findings indicate that MI and MCI were effective in preventing falls among older people living in the community with exercise intervention acting as an important component in reducing fall risk factors and

decreasing the incidence and risk of falls. Tailored health education regarding fall risk factors management, exercise, nutrition, and home modification is suggested appropriate strategy to prevent falls among community-dwelling older people. Future studies should be conducted in big databases to avoid missing important studies, and additional research from Asia is essential to prepare for future challenges of reducing falls among the elderly. Furthermore, additional study on medication management, environmental modification, and fall risk assessment is required to prove its feasibility and effect on the Asian population.

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การลดการหกล้มในผู้สูงอายุชาวเอเชียที่อาศัยในชุมชนโดยโครงการป้องกันการหกล้ม: การทบทวนวรรณกรรมเชิงบูรณาการ

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บทคัดย่อ: การหกล้มในผู้สูงอายุที่อาศัยในชุมชนเป็นปัญหาสำคัญที่น่ากังวลทั่วโลก เนื่องจากได้รับการยอมรับว่าเป็นสาเหตุสำคัญของการเสียชีวิตและการเจ็บป่วยที่เพิ่มขึ้น การทบทวนวรรณกรรมเชิงบูรณาการนี้มีวัตถุประสงค์เพื่อนำเสนอข้อมูลเชิงลึกเกี่ยวกับลักษณะและประสิทธิผลของมาตรการป้องกันการหกล้มของผู้สูงอายุชาวเอเชียที่อาศัยในชุมชน การศึกษาใช้ฐานข้อมูล MEDLINE, CINAHL, Web of Sciences, และ Embase ในการค้นหาบทความที่ตีพิมพ์ระหว่างปี พ.ศ. 2549 ถึง 2563 โดยรวบรวมงานวิจัยที่เป็นภาษาอังกฤษหรือภาษาเวียดนามร่วมกับเกณฑ์การคัดเข้าดังนี้: การป้องกันการหกล้ม ผู้สูงอายุในชุมชน และผลลัพธ์ที่เกี่ยวข้องกับการหกล้ม มีงานวิจัย 30 ฉบับซึ่งมาจากประเทศจีน ไทย ญี่ปุ่น และอิหร่านที่ผ่านเกณฑ์การคัดเข้าในการศึกษานี้ พบว่าลักษณะของมาตรการป้องกันการหกล้มแบ่งออกเป็น 5 องค์ประกอบหลัก ได้แก่ การประเมินความเสี่ยงในการหกล้ม การจัดการยา การออกกำลังกาย การปรับเปลี่ยนสิ่งแวดล้อม และสุขศึกษา โดยรวม ประสิทธิภาพของมาตรการป้องกันการหกล้มสามารถลดอัตราการหกล้มและผลลัพธ์ที่เกี่ยวข้องกับการหกล้มในผู้สูงอายุที่อาศัยอยู่ในชุมชนประเทศแถบเอเชียได้อย่างมีนัยสำคัญ อย่างไรก็ตาม ประสิทธิภาพของมาตรการป้องกันการหกล้ม การวัดผลลัพธ์ และกรอบเวลามีความแตกต่างกัน การทบทวนวรรณกรรมนี้เน้นถึงความสำคัญของการออกกำลังกายแบบผสมผสานเป็นองค์ประกอบสำคัญในการเสริมสร้างทักษะการเคลื่อนไหว ความสามารถในการทรงตัว และการเพิ่มสภาพร่างกาย การศึกษาในอนาคตควรดำเนินการจากฐานข้อมูลขนาดใหญ่เพื่อหลีกเลี่ยงการขาดงานวิจัยที่สำคัญ และควรรวมงานวิจัยจากประเทศแถบเอเชียเพิ่มเติม ซึ่งเป็นความจำเป็นในการเตรียมพร้อมสำหรับความท้าทายในอนาคตเพื่อลดการหกล้มของผู้สูงอายุ

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