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Community Health Workers and Care Managers Implement the CDC's Stopping Elderly Accidents, Deaths, and Injuries (STEADI) Program for Older Adults in a Low and Middle-Income Country: A Pilot Study

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Abstract

Background: Older adults in low-and middle-income countries experience a disproportionate burden of non-communicable diseases (NCDs). Unintentional injuries are among the major NCDs, and falls are the second leading cause of these injuries and deaths worldwide, including in Thailand. We aimed to culturally adapt the CDC's Stopping Elderly Accidents, Deaths, and Injuries (STEADI) for Thai older adults, examine the initial efficacy of STEADI using a two-group pretest-posttest design, and explore the feasibility, appropriateness, and acceptability of STEADI delivered by community health workers (CHWs) and care managers (CMs).

Methods and Results: STEADI take a coordinated care approach that consists of three steps: screening, assessing, and intervening. In Step a, CHWs screened fall risk in 20 community-dwelling older adults using three key questions and found that all of them had fall risk, then CHWs screened with a Stay Independent questionnaire (range 0-14) and found that 100% have high fall risk. In Step b, CMs assessed balance, vision, footwear, postural hypotension, medications, and CHWs assessed home hazards. They found that 50% had poor balance, 70% took 4+ medications,75% fell on the walkway, and 70% had no bathroom modifications. In Step c, individual participants received fall prevention interventions to mitigate their specific fall risk factors. CHWs and CMs indicated high acceptability, appropriateness, and feasibility of the Thai-STEADI intervention. The Thai-STEADI group had a significant reduction in the CDC fall risk score from pre-intervention (M=11.60, SD=1.52) to post-intervention (M=10.80, SD=1.64) (effect size Wilcoxon r=0.89; p=0.03) but not in the control group.

Conclusion: Our study showed that the community-based multifactorial Thai-STEADI delivered by CHWs and CMs is feasible and acceptable to prevent falls in older adults with limited access to health care.

Keywords: Assessment; Community; Fall Prevention; Public Health; Older People; Risk; Primary Care

Abbreviations: CDC: Centers for Disease Control and Prevention, STEADI: Stopping Elderly Accidents, Deaths, and Injuries, CHWs: Community health workers, CMs: Care Managers, LMICs: Low-and Middle-Income Countries, NCDs: Non-Communicable Diseases, TUG: Timed Up and Go; EBIs: Evidence-Based Collaborative Care Interventions; FOF: Fear of Falling; UC: Universal Coverage; SD: Standard Deviation; NIA: National Institute on Aging; NIMHD: National Institute on Minority Health and Health Disparities

Introduction

Falling is a chronic condition [1] that requires long-term care and support services to meet the older populations' needs (2). More than 37 million falls each year require medical attention, 684,000 people globally die from falls, and over 80% are from low-

and middle-income countries (LMICs) [2]. In addition, more than 1 billion older adults in LMICs do not have access to resources to help them stay healthy [3,4] thus, they are exposed to a high risk of falls and long-term adverse consequences. For example, Thailand will have one of the largest older populations (25%, ~17 million in 2040) among LMICs in Asia. Thailand is facing an overburdened public healthcare system [5].

One-third to half of Thai adults aged ≥ 60 years acknowledged having falls [6]. Falls were also reported in 10.4-53.5% of older people living in the community in Asia [7] and in Thai community-dwelling older adults, up to half of them had falls and fear of falling (FOF) [8-10] and physical inactivity [11,12]. A review of international fall prevention strategies indicated that no country has been able to eliminate falls in older adults [13]. There is a scarcity of implementation research in fall prevention and behavioral interventions in LMICs including Thailand. Evidence-based collaborative care interventions (EBIs), such as providing access to exercise or balance training programs are evidence-based approaches that communities can take to improve physical activity and health behaviors related to non-communicable diseases (NCDs).

There are many effective interventions that reduce falls [14-16]. Nevertheless, many studies did not consider features unique to their cultural context [7], health services and systems. Furthermore, cultural diversity affects older adults' acceptance of fall prevention interventions [17] and a meta-analysis showed a medium effect size of the effectiveness of culturally adapted interventions [18]. In Thailand, there is a lack of community-based multifactorial fall risk assessments and interventions that target both older adults and the primary care systems despite increasing calls for further spread of evidence-based collaborative care interventions in LMICs, leaving clinical practice bereft of knowledge to care for older adults. Fall prevention interventions in Thailand focused on a single intervention (e.g., balance exercise, education, home modification) and only a few studies used multifactorial interventions that targeted community-dwelling older adults but did not include fall risk screening and assessments by primary care providers [10,19].

Most falls occur at home [20] and are caused by several modifiable risk factors such as balance impairment, FOF, and hypertension [21]. Implementation programs, such as the United States (US) Centers for Disease Control and Prevention (CDC)' s Stopping Elderly Accidents, Deaths, and Injuries (STEADI) program, illuminate vital elements of coordinated care and fall prevention for healthcare providers. STEADI also provides strategies to help older adults acknowledge their fall risk and fear of falling and stay independent [22]. STEADI was developed in 2013 [1] based on three conceptual models, including the Chronic Disease Care Model [23] health communication [1] and the Transtheoretical Stages of Change Model [24]. STEADI effectively improves fall risk screening and reduces fall-related hospitalizations and medical costs in the US. [25-29].

STEADI implementation in primary care settings suggests that fall-risk screening, assessments, and individualized care plans (e.g., exercise) are effective at reducing falls and preventing chronic conditions [25,27,30,31]. STEADI Algorithm of screening, assessment, and intervention has the potential to be implemented in LMICs but has yet to be adapted and systematically implemented in any LMICs. Several behavioral interventions developed in high-income countries effectively reduce falls, however, there are many barriers to incorporating LMICs buts of initiatives in LMICs. Large-scale implementation research in Thailand demonstrates the benefits of using trained community health workers (CHWs) and care managers (CMs) to reduce behavioral and psychological symptoms of dementia [32].

We conducted a systematic review related to evidence-based fall interventions for older adults. We selected the US CDC's STEADI based on several considerations, including (a) effectiveness based on published evidence in improving fall risk screening, reducing fall-related hospitalizations and medical costs in the US [25-29]; (b) the intervention fits the needs of Thai older adults and (c) three components of STEADI would be implemented in the long-term care system using existing resources in primary care settings. In addition, the STEADI would enhance the accessibility of fall risk screening and help Thai older adults acknowledge their fall risk and stay independent. STEADI would also provide strategies to help primary care providers in tailored fall interventions [22].

Cultural adaptation is an essential action and natural step in the implementation process to improve the adoption of evidence-based interventions in LMICs. Culturally adapted STEADI for LMICs is needed and has the potential to benefit a large population. Proper adaptations of STEADI to the Thai context are necessary for creating a sustainable and effective implementation program in Thailand. We aimed to culturally adapt the CDC's Stopping Elderly Accidents, Deaths, and Injuries (STEADI) for Thai older adults, examine the initial efficacy of the Thai-STEADI for reducing fall risk and improving balance and explore the acceptability, appropriateness, and feasibility of the Thai-STEADI in primary care delivered by trained community health workers (CHWs) and care managers (CMs).

Materials and Methods

Design

This study consists of two phases, including Phase I: cultural adaptation of the CDC's Stopping Elderly Accidents, Deaths, and Injuries (STEADI) for Thai older adults and Phase II: pilot testing and assessing the acceptability, appropriateness and feasibility of the Thai-STEADI in primary care delivered by trained community health workers (CHWs) and care managers (CMs). The CMs of this study were registered nurses. A two-group pretest-posttest design was used in Phase II of this pilot study. We collected data at two-time points (pretest, posttest) to generate the effect size to power a larger trial. The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional

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Review Board of the University of Central Florida Institutional Review Board (STUDY00004288). In addition, the Institutional Review Board in Faculty of Medicine, Mahasarakham University agreed to use the UCF IRB approval for this pilot study.

Phase I: Cultural adaptation of STEADI

STEADI's tools for screening (Step a) and assessment (Step b) were culturally adapted into the Thai context [33,34] so we don't need to conduct the cultural adaptation again. In addition, a 1-year prospective study in Thailand (N=480) showed that the STEADI screening and assessment tools have high sensitivity (93.9%, 95% CI 88.8, 92.7) and specificity (75%, 95% CI 70, 79.6) to predict falls in Thai community-dwelling older adults [34]. So, we culturally adapted STEADI Step c: intervene using the following steps: 1) assess the community; 2) understand/select the intervention; 3) consult with experts/stakeholders and decide what needs to be adapted and adapt the original program; and 4) train staff and pilot test the adapted materials [35,36]. First, Assessed the current care delivery system and resources in the community. We met with the representatives from the Thai Ministry of Public Health, National Health Security Office, and local public health to assess their need and receive support to launch the study when funded. All parties agreed to select the city of Mahasarakham as the study site.

Second, Selected EBI that matches the population and context. We conducted a systematic review related to evidence-based fall interventions for older adults and selected the US CDC's STEADI based on several considerations including (a) effectiveness based on published evidence in improving fall risk screening, reducing fall-related hospitalizations and medical costs in the US [25-29]; (b) the STEADI tools for fall risk screening are easy to use by CHWs and the intervention fits the needs of Thai older adults; and (c) three components of the STEADI would be implemented using existing delivery resources in primary care.

Third, the principal investigator (LT), co-investigators in Thailand (ST, JS) and in the US (RX, BPN, JHP, WL, EE) met via zoom meetings and in-persons (LT, ST, JS) with clinicians in Thailand to decide what needs to be adapted. The decisions about adaptations were determined using input from Thai experts and stakeholders and comparing STEADI with routine practice in Thailand. Due to a shortage of registered nurses and physicians working in primary care units, the routine practice in Thailand includes using a fall prevention education flyer without providing fall risk screening and increasing the accessibility of fall prevention interventions. (Table 1) compares the original STEADI with the adapted STEADI in Thai context. (Table 1) shows a comparison of the original STEADI with the adapted STEADI in Thai context. We adapted the providers of the intervention, place of delivery, recipients, and follow-up methods/person to align with current resources and primary services in Thailand. Finally, we trained 5 CHWs and 2 CMs, aged 57.2±.3.3 (aged range 53-62), all female and 60% have 10+ years of experience in their roles to conduct the pilot study in phase II.

Phase II: Examine the initial efficacy of the Thai-STEADI for reducing fall risk and improving balance and explore the acceptability, appropriateness, and feasibility of the Thai-STEADI.

Setting and sample

Participants were recruited from low-income communities in Mahasarakham province, Thailand. Mahasarakham province is in the Northeastern region of Thailand (called Isan). Isan is Thailand's largest region, consists of 20 provinces, and is generally poorer than the rest of the country. The neighboring countries of Isan are three low-and middle-income countries including Laos, Vietnam, and Cambodia. The community area in Mahasarakham was chosen to be the study area because it is located at the center of Isan and 20% of the entire population is older adults. Participants were recruited through flyers and word of mouth. The screening, assessment and fall intervention procedures were carried out at older participants' homes, a community center, and a primary care unit.

Twenty participants who met the following inclusion criteria were enrolled:

1) ≥60 years old of age and

2) live in their own homes.

Exclusion criteria were:

1) a medical condition precluding fall risk assessments using a timed up-and-go test (e.g., on a wheelchair or bedridden), and

2) currently receiving a treatment program from a rehabilitation facility. Due to a limited budget for implementing and purchasing materials (such as grab rails) for bathroom modification, we selected 10 from 20 participants who had the highest risk of falling (the CDC's Stay Independent fall risk checklist score ≥ 10) from two villages. Village A was randomly assigned to the intervention group, and village B was assigned to the control group.

Measures

STEADI consists of three steps including screening, assessing, and intervening. The CDC's Stay Independent fall risk checklist and Time-up and go test were used for step 1 fall risk screening and step 2 assessment, respectively.

Fall Risk: Fall risk was assessed by the CDC's Stay Independent fall risk checklist. It consists of 12 statements related to physical and psychological fall risk factors with yes or no answers. A score of 4 points or higher indicates a risk of falling [22]. The sensitivity of this checklist with discriminating fallers and predicting future fallers for community-dwelling older adults is 73-80% [37].

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1.1.1. **Balance Test:** Balance test was assessed by the Timed Up and Go (TUG) test. The TUG has been widely used to assess dynamic balance, functional mobility and predict fall risk [38,39]. It provides reliable data and is validated among community-dwelling older adults [40]. The TUG has an acceptable sensitivity (87%) and specificity (87%) for assessing older adults who are prone to falls [41]. For the TUG test, participants stand up from a standard armchair, walk at a normal pace for 3 meters, return, and sit down again [42]. Participants who complete the TUG test in less than 12 seconds will be classified as having low fall risk [43].

Vision Test, Medications Review and Home Hazards Checklist: Near vision acuity was used to measure the vision test and it measured with a hand-held card like an eye chart at the distance of 16 inches. If the participants could not read, we used to count fingers at the distance of 3 meters. If the participants answer correctly at least 3 out of 4 times, they have no visual impairment. Participants were asked about the number of medications they took and asked about the type of medications related to dizziness, sleeping or anxiety pills. The home hazard checklist was focused on assessment of having grab rails/bars in the bathroom, stair, and hallway.

Acceptability, Appropriateness and Feasibility: We assess the acceptability, appropriateness, and feasibility of Thai-STEADI using the three newly developed implementation outcome measures [44]. Time to complete is less than 5 minutes per measure. Scales values range from 1 to 5 (1=completely disagree and 5= completely agree). Scales can be created for each measure by averaging responses. No items need to be reverse coded [44]. Higher scores indicate greater acceptability, appropriateness, and feasibility of the Thai-STEADI.

Data Collection and Pilot Testing of Thai- STEADI

Thai-STEADI consists of three steps including screening, assessing, and intervening [45]. The data were collected from July 2022-May 2023.

Step 1 Screening Fall Risk: Community Health Worker (CHW) provided older adults a Stay Independent self-assessment checklist or performed a quick screening with 3 questions. If older participants have at least one issue from the three, they are high risk to fall. Then CHWs performed fall risk screening using 12 questions to identify persons at high risk for falls and further assess multiple fall risk factors such as fear of falling, which could detect care needs early and thereby prevent the future need for more intensive long-term care. CHW documented the risk in the STEADI flowsheet and sent it to the Care Manager (CM). In this pilot study, CHWs screened for fall risk in 20 older adults.

Step 2 Assessing Fall Risk: Care Manager (CM) conducted fall risk assessments to determine specific fall risk factors including balance test with time, vision test, medications review, comorbidities, and home hazards. CM documented the assessments in the STEADI flowsheet and shared it to CHWs.

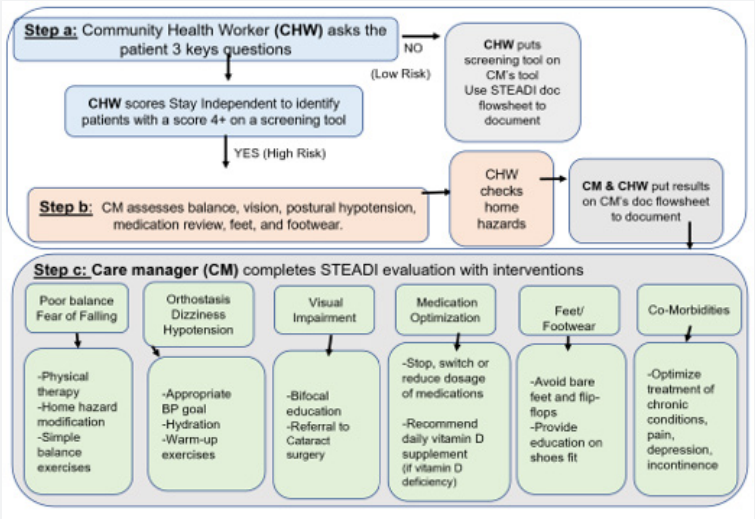

Figure 1: Thai-STEADI intervention.

Step 3 Intervening: After identifying the risk factors, the CM developed a plan based on the modifiable risk factors for the intervention group including a strength and balance program, medication management, corrective eyewear, cataract surgery, orthotics and exercise, vitamin D supplementation, and home modification [45] (Figure 1). The CM intervened via several techniques such as assisting older adults in understanding their fall risk and successfully making behavior changes based

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on the Stages of Change model [24]. If an older adult needs assistive devices (e.g., walking sticks) and home modification, the Universal Coverage (UC) scheme supported by national taxation (National Health Security Office) and district and local municipal funds usually support these needs, respectively. In addition, our program integrates with a long-term care system that can refer individuals who need specialists to the community hospital where Thai citizens can access medical care as part of three schemes including Social Health Insurance, Civil Servant Medical Benefit and UC under the national health insurance program. Besides the three steps, older adults receive the STEADI's information pamphlet (Thai language) related to fall risk, how to prevent falls, check for safety, postural hypotension, and chair rise exercise [22]. We collected data at two-time points (baseline, post-intervention). Participants from the intervention group were asked to rate the acceptability of the intervention and write their feedback or thoughts about the intervention. Control group participants were asked to review fall prevention brochures and continue their normal activities (Figure 1).

Data Analysis

The data analysis methods used in this study include descriptive statistics and the Wilcoxon signed rank test. Descriptive statistics were employed to summarize the data and provide an overview of the variables under investigation. Measures such as the mean and standard deviation (SD) were used to describe the central tendency and variability of the data. Additionally, percentages were calculated to express the relative frequencies of specific outcomes or categories. Furthermore, the range was determined to capture the spread of values observed in the data set. To evaluate the effectiveness of the intervention, the Wilcoxon signed rank test was employed. This non-parametric statistical test was used to compare the paired pre- and post-intervention total CDC's Stay Independence fall risk scores of the participants. Alpha level was set a priori at $p < 0.05$. The analysis was conducted using IBM SPSS Statistics (version 29.0) and R (version 4.2.2).

Table 1: Comparison of the original STEADI with the adapted STEADI in Thai context.

	Original STESDI Protocol	Thai-STEADI Protocol
Number of sessions	3 steps annually when patients check-in for an appointment	3 steps in 24 weeks
Providers of the intervention to patients	Medical assistant for screening, nurse for assessments, physician/Nurse practitioner/ physician assistant for intervening	Community health worker (CHW) for screening and care manager (CM) for assessments and intervening
Place of delivery	Integrating within electronic health record tools and usual clinic flow	Could-based system for delivery and mobile application for communication
Recipients	65 years and older	60 years and older
Follow-up methods/person	Visits at primary care by a care coordinator	Home visits by CHW
Language	English	Thai

Table 2: Descriptive characteristics and screening fall risk of the older participants (n=20).

Variable	Number (%)
Age Mean (SD)	76.35 (6.39)
Min - Max	61 - 89
Gender	
Female	18 (90%)
Male	2 (10%)
Chronic Conditions/Diseases	
Diabetes	12 (60%)
Hypertension	17 (85%)
Hyper cholesterol	10 (50%)
Chronic pain	5 (25%)
Cardiovascular disease/stroke	1 (2%)
Dementia	1 (5%)
Parkinson disease	1 (5%)
Admitted in the hospital in the last 6 months	7 (37%)

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Results

The majority of participants (90%) were women, mean age was 76.4 (SD=5.4, range 61 to 89) years, 85% have hypertension and 60% have diabetes. (Table 2) presents the descriptive characteristics of 20 older participants.

Step A: Screening at Home or in Community: In the quick screening, CHWs found that 100% of older participants have high risk to fall. Next, CHWs used the CDC's Stay Independent fall risk checklist (range 0-14) and found that 100% of older participants have a total score of at least 4 which indicated that all of them have high risk to fall (total scores mean 9.7 and SD= 2.4). In addition, the majority (80%) reported that they are worried about falling, 95% reported that they need to push with their hands to stand up from a chair and 90% have some trouble stepping up onto a curb (Table 3).

Table 3: Screening fall risk from older participants by community health workers.

Variable	Number (%)
Step A.1 Screening fall risk using 3 key questions	
I have fallen in the past year	12 (60%)
Sometimes I feel unsteady when I am walking	15 (75%)
I am worried about falling	16 (80%)
Step A.2 Screening fall risk using the Stay Independent	
I have fallen in the past year	12 (60%)
I use or have been advised to use a cane or walker to get around safely	16 (80%)
Sometimes I feel unsteady when I am walking	15 (75%)
I steady myself by holding onto furniture when walking at home	18 (90%)
I am worried about falling	16 (80%)
I need to push with my hands to stand up from a chair	19 (95%)
I have some trouble stepping up onto a curb	18 (90%)
I often must rush to the toilet	16 (80%)
I have lost some feeling in my feet	15 (75%)
I take medicine that sometimes makes me feel light-headed or more tired than usual	10 (50%)
I take medicine to help me sleep or improve my mood	5 (25%)
I often feel sad or depressed	6 (30%)
Total score Min=5 Max=14, Mean =9.70 (SD=2.364)	

Step B: Assessing: Care managers assessed balance, vision, feet, footwear, number of medications and CHWs assessed home hazards. They found that 50% have poor balance (Timed Up and Go score 27.3± 18.2 seconds), 70% take at least 4 types of medications, 50% have vision impairment, 80% lost some feeling in their feet, 75% fell while walking in the house and 70% lack of adaptive or assistive equipment in the home (e.g., no grab rail).

Step C: Intervening: For this pilot study, CMs selected 5 older participants who had the highest fall risk scores and provided interventions that tailored to their risk factors as presented in (Table 4) (Figure 2). Examples feedback from participants included: "This grab rail helps me. I feel more confident in doing activities in the bathroom" (Female #1, 70 years old). "I'm feeling better about myself, my fear of falling is reducing, and I do more outdoor activities" (Female #2, 68 years old). "Since joining

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this study, I haven't fallen yet. My family members don't need to help me in doing things. I can take care of myself and have more freedom" "Being more aware of my fall risk and trying to exercise more" (Male #3, 61 years old). "I like this intervention since it helps me connect with the community health worker and care manager; they are kind and provide a lot of information" (Female #4, 82 years old). "I like my community health worker and care manager; they are friendly and care about my health and safety" (Female #5 78 years old).

Figure 2: Installation of grab rails in the bathroom.

Table 4: Thai STEADI Intervention activities.

Intervention activities	Target participants
Chair exercises	Older adults with balance impairment by performing at least 10-15 minutes, 2-3 times per week for 2 months.
Installation of grab rails in bathroom and walkway (Figure 2).	Participants with home hazard environment
Blood pressure goals and medications affecting falls	Participants with hypertension
Referral for cataract surgery	Participants with visual impartment regarding to cataract
Shoes fit education and medications affecting falls	Participants with diabetes
Pain management	Participants with chronic pain.

Fall Risk

Based on the Wilcoxon signed rank test, we found that the Thai-STEADI group (N=5) had a significant reduction in the CDC fall risk score from pre-intervention (M=11.60, SD=1.52) to post-intervention (M=10.80, SD=1.64) (effect size Wilcoxon r=0.89; p=0.03) but not in the control group (N=5). The mean fall risk scores of the control group (N=5) increased from 11.0 (SD=1.0) to 11.80 (SD=0.84), but the change was not statistically significant (p=0.97). (Figure 3).

Dynamic Balance

The Thai-STEADI group had improvement in dynamic balance, and the mean of the timed-up and go test scores decreased from 20.24 (SD=23.58) to 19.60 (SD=23.31), but the decrease was not statistically significant. In addition, the mean of time up-and-go test scores in the control group increased from 38.63 (SD=21.43) to 39.47 (SD=20.83) but the increase was not statistically significant (Figure 3).

Acceptability, Appropriateness and Feasibility of the Thai-STEADI

(Table 5) shows the mean and total scores of acceptability, appropriateness, and feasibility from CHWs and CMs' perspectives. Acceptability: 60-100% of CHWs and CMs strongly agreed that STEADI meets their approval, appealing to them, they like and welcome it. Appropriateness: 60-80% of CHWs and CMs strongly agreed that STEADI seems fitting, suitable, applicable and like a good match. Feasibility: 40-80% of CHWs and CMs strongly agreed that STEADI seems implementable, possible, doable, and easy to use. Overall, CHWs & CMs indicated high acceptability (19.20±1.31 of 20 total), appropriateness (18.80±1.79 of 20 total) and feasibility (18.60±1.67 of 20 total) of the STEADI program.

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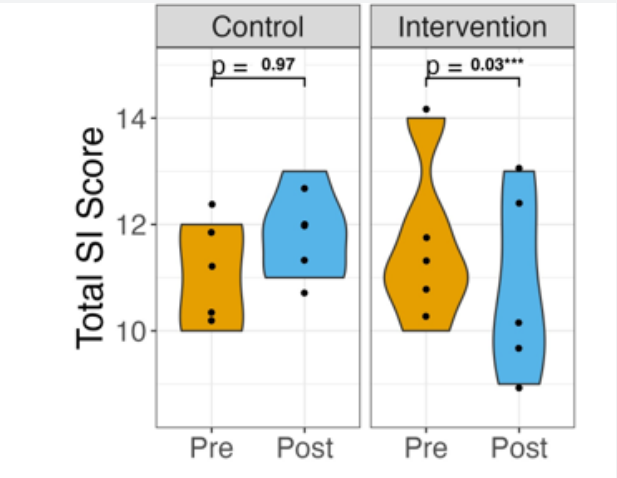

Figure 3: Pre- and post-intervention of the CDC's Stay Independent fall risk scores in the intervention and control groups.

Table 5: Acceptability, Appropriateness and Feasibility of the Thai-STEADI.

N		(%) Agree	(%) Strongly agree	Minimum	Maximum	Mean	SD
Acceptability of Intervention Measure							
Thai-STEADI meets my approval	5	0	100	5	5	5	0
Thai-STEADI appeals to me	5	40	60	4	5	4.6	0.548
I like Thai-STEADI	5	20	80	4	5	4.8	0.447
I welcome Thai-STEADI	5	20	80	4	5	4.8	0.447
Total scores of acceptability		-	-	17	20	19.2	1.304
Intervention Appropriateness Measure							
Thai-STEADI seems fitting	5	40	60	4	5	4.6	0.548
Thai-STEADI seems suitable	5	20	80	4	5	4.8	0.447
Thai-STEADI seems applicable	5	40	60	4	5	4.6	0.548
Thai-STEADI seems like a good	5	20	80	4	5	4.8	0.447
Total scores of appropriateness		-	-	16	20	18.8	1.789
Feasibility of Intervention Measure							
Thai-STEADI seems implementable	5	60	40	4	5	4.4	0.548
Thai-STEADI seems possible	5	40	60	4	5	4.6	0.548
Thai-STEADI seems doable	5	20	80	4	5	4.8	0.447
Thai-STEADI seems easy to use	5	20	80	4	5	4.8	0.447
Total scores of feasibilities		-	-	16	20	18.6	1.673
Total scores		-	-	49	60	56.6	4.561

Discussion

This pilot study aimed to

a) culturally adapt the CDC's STEADI for Thai older adults,

b) examined the initial efficacy of the Thai-STEADI in reducing fall risk and improving balance, and

c) explore the acceptability, appropriateness, and feasibility of the Thai-STEADI in primary care delivered by

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trained CHWs and CMs. To our knowledge, this study presents the first cultural adaptation of the CDC's STEADI for older adults in LMICs. In addition, our study is one of a few community-based multifactorial fall prevention interventions delivered by CHWs and CMs which focus on systematical implementation for primary care settings in LMICs.

A culturally adapted program and systematic implementation have the potential to create a sustainable intervention and improve older adults' engagement in the program and outcomes. A previous study revealed that the differences between culture, environment, exercise preference, sunlight exposure, healthcare and social welfare may influence the success of implementing falls prevention [14]. Furthermore, culturally specific risks/protective factors need to be incorporated into the evidence-based interventions in order to improve patient outcomes and patients' engagement in healthcare service [46]. A large-scale implementation research in Thailand demonstrates the benefits of a cultural adaptation of evidence-based intervention [47].

Our preliminary findings indicated the improvement of the fall risk scores and balance performance in the intervention group. Similarly, previous studies on the STEADI implementation in primary care settings, indicated that fall-risk screening, assessments, and individualized care plans (e.g., exercise) are most effective at reducing falls [27,30,31] and 75% of providers participated with 64% patients screened [30]. In addition, STEADI has shown to be effective in improving fall risk screening and reducing fall-related hospitalizations and medical costs in the U.S. [25-29]. Older adults at risk for falls who received STEADI were 0.6 times as likely to have a fall-related hospitalization than those without STEADI (p=.041) [48].

Our study showed that the community-based multifactorial Thai-STEADI delivered by CHWs and CMs is feasible and acceptable to prevent falls in older adults with limited access to health care. At the community level in Thailand, CHWs have played a key role in satisfy the need and demand for essential primary care services, and work closely with CM in sub-districts and district hospitals nationwide to improve primary care [49,50]. Similarly, implementation research for caring older adults with cognitive impairment in Thailand demonstrates the benefits of using trained community-health workers and care managers to reduce behavioral and psychological symptoms of dementia [32].

implementation research on with CHWs, a CM (nurse) provided a 3-month simple home-based balance training program and found the intervention group (n=52) improved the timed up and go test, functional reach test and FOF after 3, 6, 9 and 12 months compared with the control group (n=52) [51]. In addition, after home modifications, previous study found that participants (n=43) improved their mobility and walking distance [52]. Moreover, all participants' quality of life increased by 0.203 from 0.346 at baseline to 0.549 after the modifications [53]. A previous study in Thailand indicated that home modification in low-resourced settings is technically and financially feasible and can lead to improving physical function and quality of life [53]. Also, using CHWs and incorporating their support as older adults' peer into the healthcare system may reduce the burden on the healthcare system [54].

Furthermore, peers and community partners may influence the general uptake of and trust in health services, even in rural environments where accessibility may be difficult. In this pilot study, we leverage an existing resource in Thailand by using CHWs and CMs who are at the forefront of primary care to ensure interventions reach older adults that need them the most and to enhance interventions sustainability. The highlight of this study is supported by a recent systematic review of the strategies to implement multifactorial fall prevention which indicated that the most used implementation strategies were use of lay health workers and increasing stakeholder influence and forming coalitions [55]. CHWs normally live in the same community as older adults and are able to use fall risk screening and identify high risk groups. CHW is a key resource to create a conversation related to fall prevention and connect high-risk groups to further assessment and tailored interventions by CM (such as nurse or physical therapy).

Limitations

This study had several limitations. First, the pilot study with small sample sizes and a cross-sectional and pretest-post-test without follow-up design limited the ability to draw the effects of Thai-STEADI and establishment of causal relations. Second, social desirability may lead older participants to under or over-report their fall risk. Third, this pilot study only measured acceptability, appropriateness, and feasibility of the Thai-STEADI from the perspective of community health workers and care managers, not evaluated from older adults.

Conclusion

Primary care systems and community partners can be leveraged to stop falls and enhance older adults' well-being in LMICs. Community health workers and care managers are leaders in their communities, at the forefront of primary prevention, and play an essential role in reducing the burden on the healthcare system. The STEADI of screening, assessment, and intervention for primary care providers could be used in LMICs or low-income settings with limited resources. A culturally adapted program and systematic implementation have the potential to create a sustainable intervention and improve older adults' engagement in the program and outcomes. This project incorporates researchers and clinicians in the US and Thailand, builds on successful projects that use community health workers and care managers to assess, educate and facilitate change, and has the potential to reduce fall rates and concern for falling in Thailand, with implications for other LMICs.

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Author's Contributions

LT, ST, JS, RX, BPN, JHP, WL and EK contributed to the study conceptualization, design, and data analysis. LT wrote the original draft, and ST, JS, RX, BPN, JHP, WL and EK contributed to substantial revision of the original draft. All authors have agreed on the final version.

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