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Can EMS providers and emergency department nurses work together to identify home risk factors for falls in older people?

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Abstract

Taiwan is an aging society and the ratio of falls among the older persons is high. Most falls occur at home, and multiple risk factors including home safety are involved. We propose a novel model of emergency medical technicians (EMTs) to assess home safety using scalable checklists. This study was conducted to evaluate its feasibility. This study was conducted between April 1, 2020 and March 31, 2021. The development of the risk factor assessment scale for falls in the home environment was divided into 2 stages. In stage 1, 2 researchers reviewed the extant literature. In stage 2, 6 experts judged the content validity index. According to EMT findings, emergency department (ED) nurses checked the items in the Checklist of Risk Factors for Falls in the Home Environment. The checklists were provided to the geriatric care manager (GCM) in the ED, who then discussed potential solutions with the patients or primary caregivers. A total of 235 participants were enrolled, and EMTs carried out environment assessment for 93.2% (219/235) of them. A total of 207 participants were at risk of falls at home and 79.7% (165/207) of them received intervention measures from the GCM according to the risk items. Education was the main intervention method, with 158 subjects. Moreover, seven subjects (4.2%, 7/165) were provided long-term care resources by the GCM with occupational therapists to help improve the environment at home. Our study provides an efficient method for EMTs to assess home fall hazards.

Abbreviations: CVI = content validity index, ED = emergency department, EMS = emergency medical services, EMTs = emergency medical technicians, GCM = geriatric care manager, OTs = occupational therapists, PTs = physical therapists.

Keywords: emergency medical services, falls, home risk factors, older people

1. Introduction

According to the United Nations reports, there were 727 million persons aged 65 years or over worldwide, and this number is estimated to grow to more than 1.5 billion by 2050.[1] The percentage of the population aged 65 years or over increased from 6% in 1990 to 11% in 2019 in Eastern and South-Eastern Asia, which continue to be the regions with the fastest aging populations in the world.[1] Taiwan became an aging society in 1993, an aged society in 2018, and will become a super-aged society by 2025.[2] With these changes in the population structure, health professionals must find ways to address the medical and social needs of the aging society and take the issue seriously. The 2017 National Health Interview Survey in Taiwan reported the ratio of falls among individuals aged 65 years or over was 1/6.[3,4] In 2018, the death rate of older people over 65 due to accidental falls was only surpassed by that of traffic accidents in Taiwan.[5]

The 2017 National Health Interview Survey in Taiwan showed 8.4% of older people over the age of 65 have experienced falls in the past year, the majority of which occurred at home.[3,4] The frequency of falls increases with multiple risk factors such as age, home safety, multiple disorders. The possibility of falling is associated with an increase in the number of risk factors.[6] However, the survey found that over 60% of older individuals did not take action to prevent falls, and approximately 80% did not attempt to improve home safety after falls.[3,4]

Previous systemic review revealed that home safety assessment and interventions to modify home environment are effective in reducing falls.[7] Multiple previous trials assessing home safety and interventions have been carried out by trained personnel, mostly occupational therapists (OTs) or nurses, but sometimes by doctors and physical therapists (PTs), or even patients themselves or family members.[8–11] Prior trials supported the value of working as a team in assessing and improving home

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safety.[12] Nevertheless, there are some difficulties in including OTs for home safety assessment in Taiwan. In Taiwan, over the last decade, there has been an increase in staff shortages in health care. Approximately 1.5 times the number of currently employed nurses and PTs and about 2.7 times that of OTs are estimated to be needed to meet the needs of long term care.[13] The number of practicing OTs per 10,000 people in 2019 was 1.31 in Taiwan, compared to 4.2 in the state of Texas in 2011, and a mean of 2.0 worldwide in 2016.[14–16]

The older adults have a higher rate of emergency medical services (EMS) use than the other adults.[17,18] Identifying home safety by EMS visits was presented as a potential solution in previous studies.[19] Infinger et al developed a paramedic environmental falls risk assessment tool with 9 items including living alone, trip hazards on walkways/residence, hazardous stairs, railings, lightening, etc.[19] The participation of emergency medical technicians (EMTs) to assess home safety using scalable checklists deserves consideration for its easier adaption into routine practice. Therefore, we propose a method that is likely more suitable for the circumstances in Taiwan.

Every patient sent by EMS is required to conduct the handover from EMTs to the emergency department (ED) nurses. ED nurses record the home environmental falls risk factors and pass the record to the geriatric care manager (GCM) for further analysis. This method builds an effective connection between EMTs and the hospital's geriatric care team via the ED. However, the feasibility of this model is not guaranteed in the current literature. This study aims to assess the feasibility of a novel model of evaluating home environmental falls risks; thus improving older individuals fall prevention in Taiwan.

2. Methods

2.1. Study design

This was a prospective study include human subject.

2.2. Study setting and population

Conducted in a community hospital (Hsinchu Cathay General Hospital) in Hsinchu City with 32 ED beds, 400 ward beds, and approximately 30,000 ED visits annually. Patients over 65 years old accounted for 26% of total visits.

2.3. Study protocol

This study was approved by the Institutional Review Board of the Cathay General Hospital and was conducted according to the Declaration of Helsinki. Written informed consent was given to the patient.

The study period was April 1, 2020 and March 31, 2021. Patients who fulfilled the following inclusion criteria were included: age above 65 years, able to walk before the current ED visit, and sent to the ED by EMS. Patients who had out-of-hospital cardiac arrest and patients classified as critical condition in the triage were excluded.

The development of the risk factor assessment scale for falls in the home environment was divided into 2 stages. In the first stage, a literature search was performed by 2 researchers, one being an emergency physician with a physical-therapy background and the other being a senior EMT. It was preliminarily found that 39 items in six dimensions were important risk factors for home falls.[20–22] These six dimensions were support system, living room, bathroom, bedroom, kitchen, and stairs. However, considering the limited accessible environment and handover time after the EMT arrives at the emergency site, the dimension of kitchen was finally deleted and 8 items in five dimensions were selected by the 2 researchers to form the assessment scale. The second stage was the judgment-qualification stage of content validity index (CVI). We organized an expert panel with 6 experts in total covering four major fields (geriatrics, emergency medicine, nursing and EMS), and asked about the degrees of relevance of the 8 risk items to the research topic, which was divided into four grades on 4-point Likert scale: 1 = not relevant; 2 = somewhat relevant; 3 = quite relevant; and 4 = highly relevant. Answers of 3 or 4 were considered relevant.

2.4. Key outcome measures

We calculated the scale-level CVI (S-CVI) using two different methods, namely the average method (AVE) and universal agreement method (UA). The S-CVI/AVE value of this assessment scale was 0.96, and the S-CVI/UA value was 0.86, showing good validity.[23]

According to the findings by EMTs, the ED nurses checked the items in the Checklist of Risk Factors for Falls in the Home Environment. "Present" means that the EMS personnel found this risk factor in patients' homes, and "Absent" means that the EMS personnel did not find this problem in patients' homes. "Unavailable" means that the EMTs could not evaluate or paid no attention to this item. The ED nurses provided this checklist to the GCM in the ED. The GCM's working hours were 8 AM to 5 PM, Monday to Friday, during which the GCM discussed potential solutions face-to-face with the patients or primary caregivers. If a patient had left the hospital, the GCM communicated with them by telephone. To ensure that the EMTs and ED nurses understood the content of the assessment items before the research began, we held a training course to familiarize them with the task. They were instructed to record on the checklist, items in the home environment that could not be observed and the reasons.

In order to analyze the feasibility of this model, we performed statistical analysis of the following data: the proportion of patients for whom EMTs could perform the environment safety assessment, items that could not be assessed and the reasons, common dangerous environment factors, the proportion of patients who received intervention by the case manager, and the intervention methods.

2.4. Data analysis

We used SPSS 23.0 for Mac (SPSS Inc., Chicago, IL) to perform statistical analysis. Continuous normally distributed data are presented as mean ± standard deviation (SD). Categorical variables are presented as percentages.

3. Results

In the one-year study period from April 2020 to March 2021, a total of 1209 patients were sent to the ER by ambulance. A total of 235 patients met the enrollment criteria, including 108 males (46%) and 127 females (54%), with an average age of 77.6 ± 6.4 years. The reasons for seeking medical attention are presented in Table 1. EMTs performed environmental assessment for 93.2% (219/235) of the subjects, with only 16 subjects (6.8%, 16/235) for whom the assessment was not performed. There were two reasons for these exclusions: 93.7%

Table 1

Reasons for seeking medical attention.

Reasons for using EMS	Number (%)
Medical disease	165 (70.21%)
Surgical disease	16 (6.81%)
Fall at home	54 (22.98%)

EMS = emergency medical services.

(15/16) of the patients moved to the exit by themselves or were moved by their families, and 6.3% (1/16) of the patients were directly transported to the fire department by their families. The proportion of patients determined to have no risk factors at home was 5.5% (12/219), so 207 older individuals were at risk of falls at home. Statistics of common dangerous environment factors and items that could not be assessed are presented in Table 2. Among the 207 older people at risk, 79.7% (165/207) received intervention measures from the GCM according to risk items, while 20.3% (42/207) did not receive intervention measures. The main method of intervention was education, with a total of 158 people (95.8%, 158/165). The topics included home safety, medication, exercise, and frailty. In addition, seven patients (4.2%, 7/165) were provided long-term care resources by the GCM with OTs to help improve the environment at home.

4. Discussion

Our study provides a feasible method to assess home environment fall risk factors among the older population. EMTs can provide a realistic view of home environment safety.[19] As EMTs will actually go to patients' homes as a part of their daily work, in our research, the proportion of EMTs that could perform environment safety assessment was as high as 93.2% (219/235), which demonstrated that EMTs could not only conduct the assessment but also determine whether the scale items accord with reality through EMT practice.[19] Moreover, our sample size (N = 235) is the largest ever reported among the previously conducted pre-hospital home fall risk surveys.

Most of the previous studies adopted PTs, OTs, and nurses as the primary team members to provide home visits and assess home environment hazards.[11] Unlike our method in which EMTs assess the home hazards while carrying out their daily routines, the cost of home environment assessment by PTs, OTs, or nurses is relatively high. Therefore, in the aspect of pre-hospital assessment, we chose a working mode that requires fewer members of the workforce and less time, while simultaneously connecting EMS and hospitals to determine the risk of falls in the home environment of older persons and thus arrange intervention measures. However, this cooperation mode between EMS and ED has some difficulties and limitations. According to the literature and our experience, these include: a lack of EMS protocols, challenges in timely communication to ED staff, time constraints to evaluate the risk items, and lack of follow-up after leaving the ED.[24,25] In the busy clinical environment, possible incorrect or incomplete handover from EMTs to the ED nurse should be avoided and electronic records may help ensure the collected data are made available to ED staff when there are time constraints.[24,25] From the above analysis, the cooperation model we proposed may need to be adjusted for different regions.

This study found that the most common dangerous item is furniture in the living room, while living alone is the least common. Furniture that pose fall risks to the older people, include, for example, sofa chairs that are too soft and the arms are too low to grasp and tables or seats with sharp or slippery edges that are hard to grab or hold onto. The proportion of senior citizens living alone in Taiwan reached 15.6% of the total population aged over 65 in 2020, which is less than most of the highly developed countries, such as 30.8% in the United States, 26% in Canada, and 22.5% in South Korea in 2018.[26,27] Living alone may ensure more privacy, but is also associated with less companionship and likely lower income.[22] The majority of older persons in more developed countries are more willing to live alone for reasons of privacy and independence,[28] but in less developed countries, older people living alone often have worse quality of life and poorer health status compared to those living with family members.[28] Taiwan is a relatively familistic Asian society rooted in the concept of Confucianism that believes the family is the prototype of all social organizations. The idea of emphasizing close-knit and supportive family relationships still has a deep influence on the Taiwanese lifestyle.[29]

When the GCM finds that there is a risk in the home environment, intervention by means of health education or links with long-term care resources can help improve the home environment. The Long-Term Care Plan 2.0 (LTCP 2.0) in Taiwan provides financial support for auxiliary appliance services and home accessibility improvement services for disabled older individuals who meet the eligibility criteria.[13] In other words, LTCP 2.0 cannot serve "fairly healthy" older persons to modify the home environment.[13] Therefore, 42 patients (20.3%) in our study did not participate in the intervention plans owing to a lack of financial assistance or not meeting the eligibility criteria.

In the risk item assessment scale, the three most common items that could not be assessed were the bathroom, stairs, and the distance between the bedroom and the bathroom. The reason was that there were no stairs in the living space or EMTs did not enter the bathroom space. Infinger et al once put forward a scale with good reliability and validity to assess risk factors of falls in the home environment before going to hospital,[19] but the Taiwanese home environment was very different from that in the United States. Through a literature search and expert feedback, we present the first to attempt to adjust the fall risk assessment items to Taiwan's local features. With high

Table 2

Assessment results of risk factors of falls in the home environment.

Dimensions	Items	Present number (%)	Absent number (%)	Unavailable number (%)
Support system	The living status is living alone.	9 (3.8%)	210 (89.44%)	16 (6.8%)
Support system	There are no necessary devices for elderly persons (e.g., wheelchairs, crutches, crutches, and walking aids) or they are not placed in a convenient location for use.	55 (23.4%)	84 (35.7%)	96 (40.9%)
Living room	The lighting in the living room is not bright enough so that elderly persons can clearly see the objects, furniture, and passages in the room.	23 (9.8%)	188 (80.0%)	24 (10.2%)
Living room	The living room furniture can easily cause stumbling or falls due to poor user friendliness.	79 (33.6%)	118 (50.2%)	38 (16.2%)
Bathroom	There are no anti-skid devices (anti-skid tiles, anti-skid strips, anti-skid drainage pads, etc) on the bathroom floor or handrail devices	26 (11.1%)	12 (5.1%)	197 (83.8%)
Stairs	The stairs have no handrails or anti-skid strips.	43 (18.3%)	61 (26.0%)	131 (55.7%)
Bedroom	The height of the bed is not appropriate (the appropriate height is about 45–50 cm), and the patient cannot move safely when getting into or out of bed.	10 (4.3%)	122 (51.9%)	103 (42.8%)
Bedroom	The bedroom is far from the bathroom, making it inconvenient to use the toilet, or there is no potty chair.	13 (5.5%)	57 (24.3%)	165 (70.2%)

population density, especially in the cities (up to over 38,000 persons per km^2), there are nearly no walkways or yards leading to patient's residence.[30] The most common building types are high-rise apartments with elevators. Therefore, stairs and stair railings were not observed in these high-rise buildings as the residents use the elevators instead. These architectural characteristics can explain why the item of hazardous stairs, which was as high as 55.7% in the U.S., was absent in our research. However, if there are stairs in the living space, it may be a risk factor for falls, so we retained this item when planning the assessment scale.

4.1. Limitations

This study has four limitations. First, when recalling the home environment, different EMTs may have different memory details, However, when the EMTs are too busy due to being engaged in patient care to complete the assessment in real-time, there is still a risk of recall bias.[24,25] Training on teamwork and risk recognition skills, familiarizing EMTs with the assessment scaling tables, and more effective handover may increase the accuracy of the assessment method.[24,25] Second, we did not perform a re-assessment following home safety interventions, so the consequences of the management remain unknown. Regrettably, without collecting and analyzing post-intervention data, it is hard to determine the correlation between our introduced method and fall prevention. Furthermore, without feedback on possible improvements, some primary care team members including EMTs and ED staff may have less motive to participate in future assessment and intervention plans.[25] Third, some older people use taxis or private automobiles to reach the ED instead of making an emergency call, so our study results are unable to recognize and assess these kinds of patients.[26] Finally, our study was conducted within one city and data was collected from one ED. Hence, our study results may not be generalizable to all cities or areas, in consideration of diverse cultures and housing developments. Further studies are warranted to validate the effectiveness of this assessment approach.

Previous research has shown that clinical caregivers are often unable to obtain information about the home environment to prevent older persons from falls.[19] However, our assessment tool may provide the information that clinicians need. Without disrupting the workflow of EMTs, the tool makes the fall risk of community-dwelling older population scalable and requires no active referral by a clinician or the patient's proactive approach. In addition, 11% to 56% of EMS calls following older people falls did not result in hospital transport.[31] Up to 49% of the non-transported older people had unplanned healthcare contact including EMS contact or ED visits within 14 days of the first fall event.[31] This approach model offered more opportunities for EMTs to engage in fall prevention programs and better collaboration with hospital staff.

5. Conclusion

Our study provides an efficient method for assessing home fall hazards by EMTs, which costs less, integrates into daily work more easily, and takes advantage of the awareness and familiarity with a patient's home environment via EMTs, which is recommended for busy EDs. Due to a lack of evidence to prove the relation of these fall risk items to real fall events, future research is needed to survey the correlation of fall incidents with the utilization of the assessment tool.

Author contributions

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