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Original Article

Prevalence and factors associated with recurrent falls among middle-aged community-dwelling women

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Abstract

Objective: This community-based study evaluated the prevalence and associated risk factors of recurrent falls among middle-aged community-dwelling women in Southern-Sri Lanka. **Methods**: Randomly selected 285 middle-aged women (40-60years, Mean±SD;51.7±6.1years) participated. History of falls within the previous 12-months was inquired and those who reported two or more falls within 6-month period were considered as recurrent fallers. Age, menopausal status, weight (kg), height (m), waist-circumference (WC, cm), appendicular-skeletal-muscle-mass (ASMM, kg by DXA), hand-grip-strength (HGS, kg) and gait-speed (GS, m/s) were evaluated. Body-mass-index (BMI, kg/m2) and relative-ASMM-index (RSMI, kg/m^2) were calculated. **Results**: The prevalence of recurrent falls was 13% (95%CI; 9.4%-17.5%) (n=37). Recurrent falls were higher among postmenopausal women compared to premenopausal women, older middle-aged women (51-60years) compared to young middle-aged women (40-50years), those with low RSMI compared to normal RSMI, low HGS compared to normal HGS and low GS compared to normal GS (p<0.01). BMI and WC did not show significant associations with recurrent falls. Risk factors associated with recurrent falls were age (OR;7.41, 95%CI; 1.23-44.43, p=0.02), RSMI (OR;3.21, 95%CI; 1.00-10.32, p=0.04) and HGS (OR;3.19, 95%CI; 1.26-8.09, p=0.01). **Conclusions**: The prevalence of falls among middle-aged women was considerably high. Falls were associated with advanced age, low muscle mass and muscle strength.

Keywords: Middle-aged women, Obesity, Recurrent falls, Sarcopenia, Sri Lanka

Introduction

Globally, falls are a major public health concern because of the high morbidity, mortality and healthcare costs involved. A fall is defined as, "in-advertently coming to rest on the ground, floor or other lower level, excluding intentional change in position to rest in furniture, wall or other objects"[1]. The occurrence of more than two falls within a period of six months is defined as recurrent falls[2,3] and a person with recurrent falls requires detailed evaluation to prevent subsequent falls.

The prevalence of falls increases with age and recurrent falls are considered a major health concern among older adults. Hence, the majority of studies on recurrent falls have included older adults. Studies related to falls among community-dwelling middle-aged women, however, are sparse[4-6]. Although less prevalent compared to those in old age, diseases which predispose to falls such as gait and balance abnormalities, degenerative diseases of weight bearing joints, diabetes, hypertension and heart disease are still seen among middle-aged women[7,8]. In addition, diseases such as sarcopenia[9] and obesity[10] have been identified as risk factors of falls among middle-aged population.

According to previous studies, the prevalence of falls among middle-aged women varies from 18 to 31%[4,5]. Prevalence, risk factors and long term consequences of

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falls in those in the middle-age is still under-studied. It is important to know whether falls in middle-age is linked with falls in old age. Also it is possible that risk factors of falls are age dependent and the clinical profile of fallers in middle-age is different from that of old age. More studies are needed to answer these uncertainties and the current study was designed to determine the prevalence and risk factors of recurrent falls among middle-aged women in Southern Sri Lanka.

Materials and methods

Study design, subjects and setting

This descriptive cross-sectional study included randomly selected 285 community-dwelling healthy middle-aged women (40-60 years), selected from the Bope-Poddala Medical Officer of Health (MOH) area, Galle District in Southern Province of Sri Lanka. The women were selected by multistage cluster sampling technique. Out of the 18 Public Health Midwife divisions (the smallest community health unit) of Bope-Poddala MOH area, five were selected randomly. Houses and the female household aged 40-60 years were identified using the electoral registers of the respective areas, obtained from Grama Niladari (the local community administrative authority) of each division. There were 1920 women in 40-50 years and 1320 women in 51-60 years age groups in these five divisions. Every 12th women from the 40-50 years groups and every 6th women from 51-60 years group were selected for the study and then 160 women from 41-50 years and 220 women from 51-60 years group were included (n=380).Then, women who were pregnant or lactating, and suffering from non-communicable diseases (NCD), acute or chronic surgical conditions, and polycystic ovarian syndrome were excluded (n=95).

Data collection and measures

The number of falls in the previous 12-months was assessed by asking "have you fallen in the last 12-months". Participants were characterized as recurrent fallers if they reported "two or more falls within a period of 6-months period"[2,3] and "if so how many times have you fallen" respectively. Further, consequences of falls were assessed by asking "whether they sustain injuries following the fall".

Women were categorized pre or postmenopausal on the self-stated menstrual history based on the classification of the Stages of Reproductive Aging Workshop[11]. Women were classified as postmenopausal women if the termination of menstruation was happened within the last twelve months after the final menstruation.

Body weight was measured while fasting, with empty bladder, to the nearest 0.1 kg on light cloths while height was measured to the nearest 1 cm using a stadiometer with a beam balance (NAGATA, Tainan, Taiwan). Body Mass Index (BMI, kg/m^2) was calculated. Waist Circumferences (WC, cm) was measured with a plastic non-stretchable tape. WC was read three times with 1 mm measurement consistency among each measurement and an average of three measurements was obtained. All anthropometry indices were obtained adhering to the standard protocols[12] by the principal investigator to ensure the consistent measurements.

Appendicular Skeletal Muscle Mass (ASMM, kg) was measured with a central-type DXA scanner (Hologic Discovery W, Hologic Inc, Bedford, MA, USA) adhering to the manufacturer's protocol. The procedure was carried out by one technician who calibrated the device each scanning day. Analytical software provided by the DXA manufacturer was used to analyze Skeletal Muscle Mass (SMM). ASMM was calculated by the sum of SMM of all four limbs and the Relative ASMM (RSMI, kg/m^2) was calculated using the following formula[13]; RSMI=ASMM in kg /height in meters^2. For muscle strength, hand grip strength (HGS, kg) of the dominant side was measured[14] using the Lafayette hand held dynamometer (Lafayette Instrument Co. Ltd, Sagamore Parkway North, USA). Subjects were advised to hold the dynamometer with the dominant hand on upright position with the arm at right angles and the elbow by the side of the body[14]. For physical performance, gait speed (GS, m/s) was measured by 4 meter customary paced walking; the time taken to walk the central 4 meters of a 8 meter course at usual in a self-selected pace. To avoid the effects of acceleration and deceleration, initial and final 2 meters were excluded from the calculation. Both HGS and GS tests were done twice and the average of two measurements was used for the analyses[14].

Apart from the main variables, women's sociodemographic status and physical activity that may have influenced risk of falls were evaluated. Sociodemographic status such as employment status, monthly income, living companion and civil status using a demographic questionnaire, and the physical activity score which includes the time duration spent for walking, moderate intensity activity, vigorous intensity activity during the week prior to the interview using the Short version of International Physical Activity Questionnaire (IPAQ) (www.ipaq.ki.se). The physical activity data were converted to minutes per week and expressed as a metabolic equivalent (MET-min/week) according to the IPAQ guidelines for data processing (www.ipaq.ki.se).

Statistical analyses

Descriptive statistics; means (SD) or frequency (%), were used to describe the data. The prevalence of falls and recurrent falls were calculated as frequency (%) and presented with 95% confidence interval (CI). Prevalence of selected risk factors was compared with Chi square test of independence or Fishers' exact test between fallers and non-fallers to assess their associations with falls. Univariate logistic regression analysis was performed with unadjusted (crude) OR at 95% CI to identify factors that are associated with recurrent falls. Multiple logistic regression (backward- conditional) was applied for the variables that were significant in the Univariate analysis for retaining only

the most significant associated risk factors for recurrent falls and presented with adjusted OR and 95% CI. Same analysis was performed while controlling for the effect of sociodemographic variables (employment status, monthly income, living companion and civil status) and physical activity score and further, the analysis was repeated with the inclusion of age as a covariate in the model.

Cutoff values for BMI (<23.0 kg/m^2) and WC (80 cm)[15] and RSMI (≤5.03 kg/m^2), HGS (<9.66 kg) and GS (0.96 m/s)[16] were considered.

For the logistic regression analysis, subjects were categorized as young middle-aged women and older middle-aged women; 40-50 and 51-60 years, respectively. The RSMI status was defined as low RSMI if the RSMI was ≤5.03 kg/m^2 and optimum RSMI if the RSMI was >5.03 kg/m^2. Furthermore, HGS and GS status were also defined as low HGS and low GS if the HGS was <9.66 kg and GS was 0.96 m/s. Statistical analyses were performed using Statistical Package of Social Sciences (SPSS) version 20.0. P value <0.05 was regarded as acceptable.

Ethical considerations

All procedures of this study were performed in accordance with the ethical standards of the Helsinki declaration (1975) and its later amendments (1983). Ethical clearance for this study was obtained from Ethics Review Committee, Faculty

Characteristics	Sub group	Frequency (%)
Age (years)	40-50years	121 (57.5)
	51-60years	164 (57.5)
Menopausal status	Premenopausal women	119 (41.8)
	Postmenopausal women	166 (58.2)
RSMI	Normal RSMI	269 (94.4)
	Low RSMI	16 (5.6)
HGS	Normal HGS	253 (88.8)
	Low HGS	32 (11.2)
GS	Normal GS	240 (84.2)
	Low GS	45 (15.8)
BMI	Under-nourished to normal BMI	73 (25.6)
	Overweight to obese	212 (74.4)
WC	Normal WC	97 (34.0)
	Centrally obese	188 (66.0)
Experienced single fall		96 (33.7)
Experienced recurrent falls		37 (13.0)

RSMI=Relative skeletal muscle mass index, HGS=Hand grip strength, GS=Gait speed, BMI=Body mass index, WC=Waist circumference.

Table 1. Basic characteristics of women (n=285).

Risk factors		Recurrent fallers (n=37) n (%)	Non-recurrent fallers (n=248) n (%)	Significance (p value)
Age	40-50years	2 (5.1)	119 (48)	<0.001
	51-60years	35 (94.6)	129 (52)	
Menopausal status	Premenopausal women	3 (8.1)	116 (46.8)	<0.001
	postmenopausal women	34 (91.9)	132 (53.2)	
RSMI	Normal RSMI	30 (81.1)	239 (96.4)	<0.001
	Low RSMI	7 (18.9)	9 (3.6)	
HGS	Normal HGS	26 (70.3)	227 (91.5)	<0.001
	Low HGS	11 (29.7)	21 (8.5)	
GS	Normal GS	24 (64.9)	216 (87.1)	0.001
	Low GS	13 (35.1)	32 (12.9)	
BMI	Under-nourished to normal BMI	12 (32.4)	61 (24.6)	0.30
	Overweight to obese	25 (67.6)	187 (75.4)	
WC	Normal WC	15 (40.5)	82 (33.1)	0.37
	Centrally obese	22 (59.5)	166 (66.9)	

RSMI=Relative skeletal muscle mass index, HGS=Hand grip strength, GS=Gait speed, BMI=Body mass index, WC=Waist circumference.

Table 2. Comparison of risk factors between recurrent fallers and non-recurrent fallers.

Factor	Univariate analysis			Multivariate analysis		
	Crude OR	95% CI of Crude OR	Significance (p value)	Adjusted OR	95% CI of Adjusted OR	Significance (p value)
Menopausal status	9.96	2.98-33.28	<0.001	-	-	-
Age	16.14	3.80-68.58	<0.001	12.25	2.83-53.03	0.001
RSMI	6.19	2.15-17.85	<0.001	3.36	1.05-10.76	0.04
HGS	4.57	1.98-10.53	<0.001	3.15	1.25-7.96	0.01
GS	3.65	1.69-7.89	0.001	2.30	0.98-5.38	0.05

RSMI=Relative skeletal muscle mass index, HGS=Hand grip strength, GS=Gait speed, OR=Odds ratio.

Table 3. Risk factors of recurrent falls (n=285).

of Medicine, University of Ruhuna, Sri Lanka (Reference number; 24.09.2014:3.2). Prior to the participation, written informed consent was obtained from all participants.

Results

The Mean (SD) age of participants was 51.7(6.1) years. The majority of women were Sinhalese, married, living with their families, postmenopausal and had low monthly income. The Mean (SD) physical activity score was 7680.25(2527.73) MET-min/week. Further, most of them were either overweight or obese but had optimum muscle mass and function (Table 1).

The prevalence of a single fall was 33.7% (95% CI; 28.4%-39.3%) (n=96) and the prevalence of recurrent falls was 13% (95% CI; 9.4%-17.5%) (n=37). The distribution of number of falls was; two falls (n=25, 8.8%), three falls (n=6, 2.1%), four falls (n=4, 1.4%) and five falls (n=2, 0.7%). Among those who reported recurrent falls only eight women reported bruises while three people reported minor soft tissue injuries. Table 2 shows the association between the recurrent falls and risk factors evaluated in this study. Based on the prevalence of fallers and Chi-square test, age, menopausal state, RSMI, HGS, and GS were found to be associated with falls while BMI and WC did not show significant associations (Table 2). Risk factors associated with recurrent falls were (Table 3) age (OR; 7.41, 95%CI; 1.23-44.43, p=0.02), RSMI (OR; 3.21, 95%CI; 1.00-10.32, p=0.04) and HGS (OR; 3.19, 95%CI; 1.26-8.09, p=0.01). The results remained unchanged after adjusting for confounders such as sociodemographic status and physical activity score and the results were independent of the effect of age as the observations remained unchanged after inclusion of age as a covariate in the model.

Discussion

We observed that falls were not uncommon among middle-aged women in this study group. Further, age and measures of sarcopenia, namely muscle mass and muscle strength were associated with recurrent falls among them.

Previous studies in developed communities have also reported a high prevalence of falls among middle-aged women. In the Australian Longitudinal Study on Women's Health, the prevalence of falls among middle-aged women varied between 22% and 31% between ages 51-64 years[5]. Furthermore, Peeters et al., compares prevalence of falls among middle-aged women in three different nations, in the Netherland 27.2%, Great Britain 22% and 17.8% in Ireland[4]. In the U.S. National Health Interview Survey, the prevalence of falls in the past year among middle-aged women aged 45-54 years and 55-64 years were 12% and 15%, respectively[17]. Further, one year prospective study reported 42% incidence of falls while 17% reported multiple falls among middle-aged women aged 41-62 years in Tasmania[6].

Studies examining falls among middle-aged women from developing countries are scarce. The prevalence of falls we observed is somewhat lower compared to the prevalence reported in above studies. This could partly be due to the variation in sample size and criteria used to select study subjects. Furthermore, some studies have taken single fall also into account while others have considered more than either one fall or two falls in defining fallers.

Among the factors linked with falls, the association between age and falls has been evident in many studies[6,17]. Wang et al identified that the incidence of falls was greater in older aged middle-aged women while multiple and injurious falls was also significantly increased with aging[6]. Furthermore, balance impairment and reduced lower limb muscle strength, both of which are associated with aging[5], associate with falls. In support of this, we observed the muscle strength and physical performance which were measured as HGS and GS to be associated with falls in these middle-aged women. The link between low muscle strength and recurrent fall has been found in other studies too[18]. As HGS is significantly correlated with lower limb muscle strength, our results also supports the existing literature[19]. Sarcopenia which is characterized by low muscle mass, function and

performance starts in middle-age and gets aggravated by menopause[9]. Sarcopenia is associated with an increased risk of falling or physical disability in community-dwelling middle-aged and older adults[20,21]. Furthermore, Asian women are at high risk for sarcopenia due to the inherited existence of low muscle mass, societal discouragement of physical activities and poor dietary habits[22]. However, in general, a progressive loss of muscle mass occurs at the age of 40 at the rate of 8% per decade and increases to 15% per decade after 70 years. Muscle strength declines 10-15% per decade and more rapidly after the age of 70 years[23].

Transition from young age to old age is associated with reduced physical activity, exercise and intake of protein, especially in women. These in combination lead to reduced intracellular protein synthesis and loss of muscle mass and muscle strength[9] in middle-aged women. Even though, the American College of Sports Medicine recommends that middle-aged and older aged adults should have regular aerobic exercises, muscle strengthening exercises, and flexibility exercises[24], women in countries like Sri Lanka do not adhere to these recommendations due to a multitude of reasons. This leads to a higher risk of sarcopenia and falls among them.

Studies have reported that high BMI is associated with falls in middle-aged women[5]. We however, were unable to observe this in our study. The narrow range of BMI among our study subjects could be a reason for the inconclusive results we observed. Obesity is related to falls, as it negatively impacts balance and postural sway, thereby increasing the risk of falling[10]. Obesity is linked with impaired postural balance even in people less than 40 years of age[5,10]. Further, those with higher BMI are more likely to have NCDs, poly-pharmacy and poorer lifestyle which are also recognized risk factors of falls[5,10]. Although, menopause and hormone replacement therapy use have been identified as protective factors of falls[5], we were unable to find such associations as well.

Falls are considered a major health concern in older adults but not in those in middle-ages. This could partly be due to the under reporting of falls among middle-aged women and the less likelihood of sustaining major injuries. Fractures and cranial injuries including subdural hematoma are less common in the middle-ages and they recover from soft tissue injuries quicker compared to those in old age. Although serious injuries are uncommon, fragility fractures are seen in those in middle-age. Particularly the Colles' fracture in women begins around 40 years and gradually increases with age[25]. Although uncommon, hip and vertebral fractures are seen among premenopausal women and the osteoporosis related fracture risk calculation model (FRAX) has been calibrated add estimate fracture risk from the age of 40 years[26]. Therefore, our findings encourage the screening of middle-aged women, particularly those with high risk factors, for falls and advising them on health promotion activities. These include measures to prevent sarcopenia, especially the aerobics, strength and balance training exercises and dietary modifications.

Our study had a few strengths and weaknesses. Studies assessing the association between sarcopenia and falls are sparse in Asian countries. Furthermore, most of the previous studies have included older women and men. The current study addressed three different attributes of skeletal muscles; mass, strength and performance and these can be considered the strengths of the study. The major drawbacks of the study include single study setting and cross-sectional design. This would limit the generalizability of the findings of the current study. Furthermore, recall bias where subjects failed to report minor falls and those not associated with injuries would have underestimated the fall incidence reported. Some women might have forgotten about falls they had, especially if they were uncomplicated and not associated with serious injuries. This recall bias may have underestimated our estimations. Therefore, we suggest further studies with the inclusion of multiple study sites and prospective follow up with regular contacts to improve the accuracy of data.

In conclusion, a high prevalence of recurrent falls among community-dwelling middle-aged women were observed in this cross-sectional study. Age and the measures of sarcopenia especially low muscle mass and muscle strength were associated with the recurrent falls prevalence.

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