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Research article

Association between demographic characteristics, lower limb range of motion, functional performance, ability to dual task, quality of life and risk of falls in older adults of the United Arab Emirates - A cross-sectional study

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A R T I C L E I N F O

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A B S T R A C T

Background: With increasing age, decreased range of motion of lower limb joints, impaired functional performance and balance, pain status, altered dual tasking, and poor quality of life may predict the risk for falls in older adults. Therefore, this study aimed to identify which of the aforementioned variables and demographic factors predict falls in older adults in the United Arab Emirates. In addition, the study examined the association between demographic characteristics and the risk of falls in older adults.

Methods: This cross-sectional study included 100 (50 women) community-dwelling older adults (age: 75 ± 3.6 years). Participant demographic characteristics (sex, age, body mass index, limb dominance, exercise status, etc.) were documented. The independent variables included the outcomes of demographic characteristics, active range of motion of the hip, knee, and ankle, single-leg stance, five times sit-to-stand, timed up and go test, dynamic gait index, pain, and World Health Organization Quality of Life Assessment-Bref questionnaire. The dependent variable was the risk of falls (self-reported presence or absence of falls) in the past 12 months.

Results: Out of 100 older adults, forty-two reported a fall and among them 26 were women. Many of the independent variables were significantly associated with the risk of falls in univariate analysis. However, multivariable logistic regression revealed that none of them were independently associated with the risk of falls in older adults living in the United Arab Emirates.

Conclusions: Relying specifically on one of the included variables as an independent (risk) factor associated with falls in older adults of the United Arab Emirates warrants further investigation.

1. Introduction

Throughout the world, the number of older adults over 65 years of age is increasing rapidly than any other age group. Consequently, an increase in the number of falls among this age group is plausible [1]. Ungar et al. (2013) defined falls as "accidental events in which a person falls when his/her center of gravity is lost and no effort is made to restore balance or when this effort is ineffective" [2]. Falls are considered as a major barrier for the continuation of a good healthy life [1], and they are directly related to poor health-related quality of life (QOL), mortality, and morbidity of older adults [3].

Over 33% of community-dwelling people aged over 65 years fall at least once a year, and of those 50% will have recurrent falls [3]. According to a systematic review and meta-analysis by Alqahtani et al. (2019), the prevalence of falls among older adults of the Gulf Cooperation Council countries (including the UAE) has been reported to be 47%, and this prevalence is much higher than previous reports from western countries [4]. Since falls are considered as a major cause of frailty, immobility, and acute and chronic health impairment in older persons, it may lead to major neurological impairments which make the risk of falls considerably high [5]. Furthermore, falls lead to 20–30% of mild to severe injuries and are the underlying cause of 10–15% of all emergency

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department visits [6]. More than 50% of injury-related hospitalizations among people over 65 years older are due to falls [7].

There are a few published studies on the relationship among the range of motion (ROM), functional strength, pain, QOL, dual tasking, and falls among older adults. One previous study reported a decrease in passive ROM of the hip (extension, internal rotation, and abduction), ankle (dorsiflexion), and gastrocnemius flexibility in older adults with a history of falls as compared to those without falls [8]. Moreover, a decrease in active ROM of the hip can affect dynamic balance and increase the risk of falls in older adults [9]. With increasing age, older adults tend to develop a poor upper and lower body functional strength and face a greater risk of falling. Moreover, a single-leg stance could be used to predict the risk of falls in older adults [10, 11]. Pain has been found to be associated with an increased risk of falls in older adults [12]. A relationship between QOL and fear of fall has been documented [13].

The timed up and go (TUG) test appears to be a valid method for screening the risk for falls in older adults [14]. The dual TUG test may be more capable than the single TUG test to detect differences and classify fallers and non-fallers among older adults [15]. The results of a prospective study showed that older adults who performed TUG-cognitive test with slower time and had lower dual-task ability were at a high risk of falling [16]. However, a study found that the TUG test has limited ability to predict falls in older adults [17].

Identifying the demographic characteristics of older adults would allow us to determine the characteristics of this population, which could be extremely useful to help older adults who are at a risk of fall. The detection of fall risk factors is essential to implement effective and specifically tailored fall prevention strategies and rehabilitation interventions in order to limit the incidences related to falls among the older population [18]. However, there is limited information on falls and associated risk factors among older adults in the United Arab Emirates (UAE), a high-income developing country. Indeed, falls (55%) and road traffic collisions (32%) are reported to be the two most common mechanisms of trauma among older adults in the UAE [19]. In the UAE, there is a lack of studies on falls in elderly people. Hence, in this study, we investigated the association between demographic (sex, age, exercise status, using an assistive device, etc.) characteristics, lower extremities active ROM, functional strength, ability to dual task, QOL and the risk of falls among older adults in the UAE.

2. Methods

2.1. Study design

This was a cross-sectional, predictive correlation study. Ethical approval for the study was obtained from the Research Ethics Committee of the University of Sharjah (REC-20-05-21-01-S). A written informed consent was obtained from all participants before data collection. They were assured of confidentiality and anonymity of the data collected. The study meets the ethical requirements of the declaration of Helsinki (2013) [20].

2.1.1. Participants

One hundred community-dwelling older adults (50 men), aged 65 years and above, with and without a history of falls were recruited from the UAE through convenience sampling, based on the eligibility criteria mentioned below, from September 2020 to March 2021. Participants were recruited from community centers through advertisement with flyer distribution and by word of mouth. All eligible participants who volunteered to participate were enrolled in the study. Volunteers were excluded if they have had any of the following (identified with a health screening questionnaire): history of smoking, chronic obstructive pulmonary disease, chronic cardiac disease, asthma, lower limb surgery (e.g., arthroplasty of the hip or knee), lower limb deformity requiring a heel lift on shoe, and visual or vestibular problems.

2.1.2. Sample size estimation

The sample size was estimated to be 96 assuming the proportion of falls among older adults to be 47% [4] at a 95 % confidence level and a 10% margin of error (absolute precision). Therefore, one hundred older adults were deemed sufficient for study.

2.1.3. Procedure

All participants filled in a screening questionnaire (English or Arabic version) which included questions on demographic information, health status, and the World Health Organization Quality of Life (WHOQOL-BREF) questionnaire. The WHOQOL-BREF has been found to perform well with sick and healthy participants, demonstrating satisfactory psychometric properties [21]. This questionnaire has been recommended for clinical and general populations and for assessment or intervention evaluation [21].

Height was measured using a stadiometer (Seca, Medical Measuring Systems and Scales, Germany) and weight was measured using a weighing electronic scale (Trading Company, Guangdong, China). Body mass index (BMI) was calculated by taking the ratio of body weight and height (kg/m^2). The following variables were measured for all older adults.

2.2. Independent variables

2.2.1. Lower extremity active ROM

Active ROM including flexion/extension, abduction/adduction, and internal/external rotation of the hip, flexion/extension of the knee, and plantar flexion and dorsiflexion of the ankle were measured using a goniometer (12″ Baseline 360 Degree Goniometer [12–1000] and 6″ Baseline 360 Degree Goniometer [12–1002], QM338800, Fabrication Enterprises, USA) based on standardized techniques. To normalize the data, each participant's ROM was converted into a percentage of normal using the following equation: (subject ROM/normal ROM) $\times$100 for each movement [8].

2.2.2. Gross functional performance and balance

To assess functional performance, balance, and motor control abilities, the following tests were employed.

2.2.3. Single-leg stance test

This test has shown evidence of construct validity based on its association with hip abductor function [22]. The participants were made to stand upright with their feet together, and for them to remain safe while performing the test, they held on to a stable object like a chair, and then lifted one foot off the ground [22]. The physiotherapist used a watch to count the seconds the participants were able to stand on one foot and recorded this number. During the test, the participants were in a safe environment under the observation of the therapist.

2.2.4. Five times sit-to-stand assessment (FTSST)

The FTSST is a valid measure of dynamic balance and functional strength in older adults [23]. The test is found to be reliable and valid to measure functional muscle strength [24]. A high ICC and a low SEM and SEM% suggest excellent relative and absolute reliability, respectively, of the FTSST in older adults [23]. Changes in FTSST performance should exceed 2.5 s to be considered a real change beyond measurement error [23].

The participants began by crossing their arms on their chest and sitting with their back against the chair. The therapist provided the following instructions: “I want you to stand up and sit down 5 times as quickly as you can when I say 'Go'”. Started timing when the participant heard the word “Go” and stopped when the participants’ buttocks touched the chair on the fifth repetition. Measurement: The time stopped when the participant stood at the fifth time [23].

2.2.5. TUG (normal, dual, and cognitive)

TUG-normal test: The TUG-normal test is a reliable, valid, and easy-to-administer clinical tool for assessing advanced functional mobility [25]. The participant started in a seated position, stood up upon therapist's command, walked three meters, turned around, walked back to the chair, and sat down. They were allowed to use an assistive device [26]. The normative reference values by age for TUG test are 8.1 (7.1–9.0 [95% confidence intervals]), 9.2 (8.2–10.2), and 11.3 (10.0–12.7) for 60–69, 70–79, and 80–99 years, respectively [26].

TUG-cognitive test: Participants were asked to complete the TUG task while counting backward by threes from a randomly selected number between 20 and 100 [27].

TUG-dual test: Participants stood up from a chair, walked three meters while holding a cup filled with water, turned around, walked back to the chair, and sat down [14].

The time taken to complete the three tasks was noted.

2.2.6. Dynamic gait index (DGI)

The DGI showed high reliability and showed evidence of concurrent validity in fall prediction compared to the Berg Balance Scale, timed walking test, TUG, and Activities-specific Balance Confidence Scale. It has been reported to be a useful clinical tool for evaluating dynamic balance in ambulatory people with chronic stroke [28]. Test included eight steps: gait on a level surface, change in gait speed, gait with horizontal head turns, gait with vertical head turns, gait and pivot turn, step over obstacle, step around obstacles, and climbing stairs [28].

2.2.7. Assessment of quality of life

The WHOQOL-BREF questionnaire consisting of 26 questions was used to assess QOL, health, and well-being over the previous two weeks for older adults. All questions were graded with numbers from 1 to 5 on a Likert scale where 1 represents "disagree" or "not at all" and 5 represents "completely agree" or "extremely" [29]. The questionnaire covers four domains each with specific facets: physical health (7 items), psychological health (6 items), social relationships (3 items), and environmental health (8 items); it also includes of the level of independence and general health items. The physical health domain includes items on mobility, daily activities, functional capacity, energy, pain, and sleep. The psychological domain measures include self-image, negative thoughts, positive attitudes, self-esteem, mentality, learning ability, memory concentration, religion, and mental status. The social relationships domain contains questions on personal relationships, social support, and sex life. The environmental health domain covers issues related to financial resources, safety, health and social services, living physical environment, opportunities to acquire new skills and knowledge, recreation, general environment (noise, air pollution, etc.), and transportation [30]. The WHOQOL-BREF has shown good discriminant validity, content validity, internal consistency, and test–retest reliability in adult sick and well respondents [31].

2.2.8. Visual analog scale (VAS)

VAS consists of a straight line with the endpoints defining extreme limits such as no pain, moderate pain, and worst pain. The patient is asked to mark his pain level from 0 to 10 [32]. A few studies reported that the VAS had an excellent test–retest reliability for the measurement of osteoarthritic knee pain for older adults, as well as fair concurrent validity with VAS fear of fall among older adults [33, 34].

2.3. Dependent variable

2.3.1. Risk of falls

Older adults were asked whether they had fallen in the past one year. The presence or absence of falls in the past year was recorded and analyzed as an outcome.

2.4. Statistical analysis

Descriptive statistics were reported using means, standard deviations, frequencies, and/or percentage distributions as appropriate for the type of data collected. Factors affecting the risk of fall among elderly were determined using binary logistic regression analyses. The dependent variable for the logistic regression analysis was the presence or absence of falls. The logistic regression was performed in two stages: univariate logistic regression and multivariable logistic regression. Using univariate logistic regression analyses between the dependent variable (falls vs. no falls) and each independent variable (demographic characteristics, lower extremity active ROM, single-leg stance for both limbs, FTSST, TUG [normal, cognitive, and dual], DGI, WHOQOL-BREF, and VAS for pain), crude or unadjusted odds ratios were calculated. In multivariable logistic regression analysis between the dependent variable and all the independent variables which were found to be significant in univariate logistic regression analyses, adjusted odds ratios were calculated. Odds ratio with 95% confidence intervals were reported. P-value <0.050 was considered to be statistically significant. All statistical analyses were carried out using the Statistical Package for Social Science (SPSS) (IBM SPSS, version 27, Armonk, USA).

3. Results

A total of 100 participants completed the assessments and questionnaires giving a response rate of 100%. Table 1 shows the sociodemographic characteristics of the study participants. The proportion of the participants were equal for both sex (50 each). More than half of the participants were in the age group of 65–69 years of age (61/100)

Table 1. Descriptive statistics: demographic and anthropometric characteristics and a history of falls in older adults of the United Arab Emirates.

Variable	Percentage (%) (n = 100)	History of falls, n (%)	
		No (n = 58)	Yes (n = 42)
Sex			
Female	50	24 (48)	26 (52)
Male	50	34 (68)	16 (32)
Age group, years			
65–69	61	45 (73.8)	16 (26.2)
70–74	17	8 (47.1)	9 (52.9)
≥75	22	5 (22.7)	17 (77.3)
Nationality			
Emirati	75	36 (48)	39 (52)
Non-Emirati	25	22 (88)	3 (12)
Body mass index, kg/m^2			
Normal weight (18–24.99)	30	20 (66.7)	10 (33.3)
Overweight (25–29.99)	39	22 (56.4)	17 (43.6)
Obese (≥30)	31	16 (51.6)	15 (48.4)
Dominant side			
Right	94	55 (58.5)	39 (41.5)
Left	6	3 (50)	3 (50)
Exercise status			
No	56	22 (39.3)	34 (60.7)
Yes	44	20 (58.8)	8 (18.2)
Smoking status			
No	66	38 (57.6)	28 (42.4)
Yes	34	20 (58.8)	14 (41.2)
Diabetes status			
No	51	32 (62.7)	19 (37.3)
Yes	49	26 (53.1)	23 (46.9)
Using assistive device			
No	77	55 (71.4)	22 (28.6)
Yes	23	3 (13)	20 (87)

and were Emiratis (75/100). More than half (58/100) of the respondents reported that they did not have a fall in the past two years. Older adults in the study were overweight (39/100), obese (31/100), or with normal BMI (30/100). The majority of older adults were right-side dominant (94/100). Around 56% (56/100) of them reported that they were not doing any exercises. Among 100 older adults, 66 were nonsmokers, and 49 had a history of diabetes. Dependence on an assistive device was not prevalent among the included participants because 77 (out of 100) of them were not using any assistive device.

Thirty-nine participants (39/42) who experienced a fall were Emiratis. Thirty-two participants (32/42) who reported falls were overweight or obese. Three (3/6) who had the left lower limb as the dominant side had falls. Thirty-four adults (34/56) who were not doing exercises had falls. Most of the participants who reported falls were non-smokers (28/42). Twenty-three (23/42) with a history of falls had diabetes. Twenty older adults (20/23) who were using an assistive device had falls.

Table 2 shows the results of univariate and multivariable logistic regression analysis for factors associated with a risk of fall (fall vs. no fall). In univariate analysis, the following variables were found statistically significant: sex (odds ratio [OR] = 2.30, 95% confidence interval [CI]: 1.02 to 5.19, p = 0.044); older adults aged 70 years and above (OR = 3.16, 95% CI: 1.04 to 9.60, p = 0.042) and 75 years and above (OR = 9.56, 95% CI: 3.03 to 30.16, p < 0.001); exercise status (OR = 0.14, 95% CI: 0.06 to 0.37, p < 0.001); using an assistive device (OR = 0.06, 95%

Table 2. Univariate and multivariable logistic regression findings for factors associated with a history of falls in older adults of the United Arab Emirates.

Variables	Mean	SD	Univariate analysis		Multivariable analysis	
			Odds ratio (OR) with 95% CI	p	Adjusted OR with 95% CI	p
Numbers of fall (year)	0.70	0.99				
Gender						
Male			1			
Female			2.30 (1.02, 5.19)	**0.044**	2.13 (0.55,8.23)	0.272
Age Group						
65–69 years			1			
70–74 years			3.16 (1.04, 9.60)	**0.042**	0.45 (0.07, 2.93)	0.403
≥75 years			9.56 (3.03, 30.16)	**<0.001**	1.26 (0.20, 8.03)	0.809
Exercise Status						
No			1			
Yes			0.14 (0.06, 0.37)	**<0.001**	0.34 (0.08, 1.47)	0.148
Assistive Devices						
No			1			
Yes			0.06 (0.02, 0.22)	**<0.001**	6.89 (0.96, 49.39)	0.055
VAS	3.49	2.58	1.08 (0.93, 1.26)	0.329		
Rt SLS test (s)	18.74	27.51	0.88 (0.83, 0.95)	**<0.001**	1 (0.96, 1.04)	0.982
Lt SLS test (s)	15.53	7.07	0.87 (0.81, 0.93)	**<0.001**		
FTSST (s)	13.25	2.97	1.27 (1.08, 1.50)	**0.004**	0.97 (0.71, 1.32)	0.831
TUGT normal (s)	10.77	3.01	1.31 (1.10, 1.55)	**0.002**	0.85 (0.34, 2.14)	0.727
TUGT dual (s)	11.29	3.28	1.24 (1.07, 1.43)	**0.005**	0.61 (0.24, 1.54)	0.295
TUGT cognitive (s)	12.31	3.37	1.35 (1.16, 1.58)	**<0.001**	1.88 (0.84, 4.20)	0.126
DGI	19.92	3.98	0.66 (0.54, 0.81)	**<0.001**	0.81 (0.57, 1.17)	0.264
Lower limb active ROM						
Percentage normal Rt Hip ROM - all planes combined	80.14	13.28	0.91 (0.87, 0.95)	**<0.001**	0.79 (0.48, 1.30)	0.350
Percentage Normal Rt Knee ROM	72.70	14.46	1.01 (0.98, 1.04)	0.41	0.82 (0.43,1.57)	0.556
Percentage Normal Rt Ankle ROM	87.67	12.83	0.92 (0.88, 0.96)	**<0.001**	0.84 (0.45, 1.60)	0.593
Percentage Average Rt LL ROM all joints	80.17	8.90	0.89 (0.84, 0.94)	**<0.001**	1.70 (0.25, 11.67)	0.591
Percentage normal Lt Hip ROM - all planes combined	43.71	6.72	0.76 (0.68, 0.86)	**<0.001**		
Percentage Normal Lt Knee ROM	73.17	14.46	1.01 (0.98, 1.04)	0.39		
Percentage Normal Lt Ankle ROM	88.61	12.02	0.91 (0.86, 0.95)	**<0.001**		
Percentage Average ROM of all joints - Lt LL	98.93	6.11	0.92 (0.86, 0.97)	**0.022**		
QOL						
WHOQOL Domain 1	67.01	18.27	0.95 (0.93, 0.98)	**<0.001**	1.07 (0.97, 1.17)	0.176
WHOQOL Domain 2	73.26	15.44	0.95 (0.92, 0.98)	**0.001**	0.999 (0.91, 1.09)	0.991
WHOQOL Domain 3	62.70	21.13	0.96 (0.93, 0.98)	**<0.001**	0.968 (0.92, 1.02)	0.246
WHOQOL Domain 4	70.08	15.77	0.98 (0.96, 1.01)	0.198		

Abbreviations: CI: confidence interval, DGI: dynamic gait index, FTSST: five times sit to stand test, LL: Lower limb, Lt: left, ROM: Range of motion, Rt: right, SLS test: single leg stance test, TUGT: time up and go test, VAS: visual analog scale, WHOQOL: World Health Organization quality of life.

CI: 0.02 to 0.22, $p < 0.001$); right single-leg stance test (OR = 0.88, 95% CI: 0.83 to 0.95, p = <0.001); left single-leg stance test (OR = 0.87, 95% CI: 0.81 to 0.93, p = <0.001); FTSST (OR = 1.27, 95% CI: 1.08 to 1.50, p = 0.004); TUG-normal test (OR = 1.31, 95% CI: 1.10 to 1.55, p = 0.002); TUG-dual test (OR = 1.24, 95% CI: 1.07 to 1.43, p = 0.005); TUG-cognitive test (OR = 1.35, 95% CI: 1.16 to 1.58, $p < 0.001$); DGI (OR = 0.66% 95% CI: 0.54 to 0.81, $p < 0.001$); right hip ROM (OR = 0.9, 95% CI: 0.87 to 0.95, $p < 0.001$); right ankle ROM (OR = 0.92% 95% CI: 0.88 to 0.96, $p < 0.001$); right lower limb ROM of all joints (OR = 0.89, 95% CI: 0.84 to 0.94, p = <0.001); left hip ROM (OR = 0.76% 95% CI: 0.68 to 0.86, $p < 0.001$); left ankle ROM (OR = 0.91, 95% CI: 0.86 to 0.95, $p < 0.001$); left lower limb ROM of all joints (OR = 0.92, 95% CI: 0.86 to 0.97); WHOQOL Domain 1 (physical) (OR = 0.95, 95% CI: 0.93 to 0.98, $p < 0.001$); WHOQOL Domain 2 (psychological) (OR = 0.95, 95% CI: 0.92 to 0.98, $p < 0.001$); and WHOQOL Domain 3 (social relationships) (OR = 0.96, 95% CI: 0.93 to 0.98, $p < 0.001$).

We did risk adjustment for covariates (demographic characteristics, lower extremity active ROM, single-leg stance for both limbs, FTSST, TUG [normal, cognitive, and dual], DGI, WHOQOL-BREF, and VAS for pain with significant p values in univariate analyses) in multivariable logistic regression analysis. However, none of these variables were independently associated with the risk of falls in the multivariable analysis.

4. Discussion

The present study is the first study in the Middle East to determine the association between demographic characteristics, lower extremities active ROM, functional strength, ability to dual task, and the risk of falls among older adults. Our findings indicated that many of these variables were found to be significantly associated with the risk of falls in older adults in univariate analysis. However, multivariable logistic regression revealed that none of them were independently associated with the risk of falls in older adults living in the UAE. Therefore, relying on one of these variables to be an independent predictor of the risk of falls in older adults of the UAE requires further substantiation in prospective cohort studies.

One of the primary findings in our study was that women were more likely to experience falls than men, which appears to be consistent with similar observations [35]. This could be a consequence of decreasing bone mass in women that occurs faster than that of men, especially after menopause [36]. Although one study from Nigeria reported similar findings [37], another study from Germany reported the opposite [38]. The differences between these findings in different countries among older adults between men and women could be related to different biological, social, or environmental characteristics among other factors.

Age was significantly associated with the risk of falls among older adults in our univariate analysis but not multivariable analysis. Likewise, a strong relationship between increasing age and the risk of fall has been reported in other studies [36, 39] which warrants further investigation. Moreover, one study from Saudi Arabia reported an opposite finding [36].

There was a significant association between performing exercises and risk of falls in the older adults. Indeed, performing exercises can prevent falls among older adults [40]. Our findings are in concordance with previous studies that showed that the older adults who use assistive devices are more exposed to falls [36, 41, 42]. However, there have been claims that the use of assistive devices protected the older adults against falls [43].

Although a meta-analysis reported that older adults with pain were more likely to experience falls in the past 12 months [44], pain (VAS scores) did not predict the number of falls among older adults. Leveille et al. (2002) found that older adults especially women with pain who were receiving analgesics had lower fall risk than non-users [45]. It might be possible that participants in our study might have used analgesics which were not documented during assessment.

The single-leg stance test was associated with the risk of falls among older adults in univariate analysis. In addition, other previous studies have found that this test could help to predict the fall risk [11, 46]. The FTSS test has been reported to have a significant predictive value for falls in the community-living older adults (aged 65 + years) [47] and such an association was evident in our univariate logistic regression analysis. Nevertheless, these variables ability to predict the risk falls could be related to several other variables (covariates) reported in our study.

Our univariate analysis revealed a significant association between the risk of falls and the TUG-normal, TUG-dual and TUG-cognitive tests. The TUG test has been reported to identify patients at risk for falls due to cognitive impairment [48]. However, in disagreement with other studies [47, 49, 50, 51], our multivariable analysis revealed that the TUG tests were not independently associated with the risk of falls in older adults living in the UAE.

Herman et al. (2009) stated that the DGI is a very important test in predicting the risk of fall for older adults as it measures the gait instability and evaluates not only usual walking, but also walking during more challenging tasks as a demand of changing the position during walking [52]. Another study used DGI as a tool for assessing older adults which showed a strong correlation among commonly used clinical tools used to evaluate balance and mobility function in older adults [14]. However, our findings reveal that DGI could be related to other factors (see Table 2) and may not be independently associated with the risk of falls in older adults.

Our study showed that normalized right and left hip and ankle ROM (all planes combined) was found to be associated with the risk of falls among older adults in univariate analysis but not in multivariable analysis. Moreover, another study has also reported a significant correlation between hip ROM and the number of falls in older adults [9]. It has been shown that a significant reduction in ROM of all the lower limb joints including the hip and ankles could influence the risk of falls among older adults. In fact, another study stated that a limitation in hip and ankle ROM would affect the musculoskeletal system and result in loss of balance and falls among older adults [8]. ROM for hip extension, hip internal rotation, hip abduction, ankle dorsiflexion have been reported to be significantly decreased in fallers older than 60 years because of reduced hip extension combined with an anterior tilt of the pelvis and associated tightness in hip musculature. This could be a primary reason for a decrease in stride length and walking speed in elderly fallers [8]. A significant reduction in hip ROM among older fallers has been reported when compared to non-fallers [8]. Arnold et al. (2012) reported that the hip muscle strength plays a major role in the balance of older adults as the hip joint bears the largest amount of the body weight during walking. So, with increasing age, weakness in the hip muscles could lead to more compressive forces on the hip joint and a decrease in balance which might account for a risk of falls in older adults [49].

We found that the WHOQOL-BREF scores of the Domains 1 (physical), 2 (psychological), 3 (social relationships) were associated with the risk of falls for older adults living in the UAE based on univariate analysis. However, when adjusted for other covariates in multivariable logistic regression, the WHOQOL-BREF scores were not independently associated with the risk of falls. According to the WHOQOL-BREF scores reported in a previous study, the QOL of the older adults was either good or very good, even when there is a reasonable percentage of falls and gait disturbances among them [53]. On the contrary, a strong association between QOL and fear of fall has been reported [13]. In fact, we presume that the QOL is a generic outcome measure influenced by several factors including but not limited to the risk of falls in older adults.

More than half (17; 77.3%) of our participants who reported a fall were 75 years and above in the previous year. This 77.3% prevalence of falling is higher when compared to other countries: (49.9%) in Riyadh [54], 44.2% in Saudi [55], 60.3% in Egypt [56], 34% in Canada [57], 42.4% in the UK [58], 32% in the USA [59], and 34.7% in Ecuador [60]. However, differences in fall risk between studies could be attributed to personal characteristics, health status, comorbidities, physical activity levels, environmental factors, and lifestyle of older adults in addition to sample size [61].

4.1. Strengths and limitations of the study

Our study is the first of its kind in the UAE to study the association between demographic characteristics, lower extremities active ROM, functional strength, ability to dual task, QOL and the risk of falls among older adults. The study has some limitations. Some of the older adults may under-report the number of fall episodes during a 12-month period because of recall bias. Medical history, medications use, environmental factors, physical activity levels, lifestyle, nutritional status, and fear of falling could be other potential risk factors of falls, and these require further investigation. Self-reported answers in the questionnaires may be overstated or understated, and the participants might not be comfortable to reveal personal information such as psychological and personal issues, drugs doses, and frequency of administration that may be needed for the study. Moreover, cognitive function could be objectively screened using an appropriate tool (e.g. the mini-mental state examination) in older adults in the future studies as this would be important for studies investigating outcomes self-reported by the participants. However, none of our included patients had a diagnosed history of dementia or any other major illness affecting cognition at the time of the study according to their medical records. Further large prospective studies with adequate follow-up are required to substantiate findings in this area.

4.2. Implications for research and clinical practice

Further prospective cohort studies must now be undertaken to identify all the factors that are present in the older adults' life which would independently predict falls. We recommend frequent assessment for frailty in older adults by a multidisciplinary team, based on high-quality clinical practice guidelines [62], in order to meet the needs of community-dwelling older adults at risk of falls in the UAE.

5. Conclusion

Our findings indicated that many of the included independent variables (demographic characteristics, lower extremities active ROM, functional strength, ability to dual task, and the risk of falls among older adults) were found to be significantly associated with the risk of falls in older adults of the UAE in univariate analysis. However, none of them were independently associated with the risk of falls in older adults living in the UAE as evident in the multivariable logistic regression. Therefore, relying specifically on one of these variables as an independent (risk) factor associated with falls in older adults of the UAE warrants further investigation. The risk of falls might be associated with several factors and they might be inter-related which must be further substantiated in longitudinal cohort studies. The current findings must be taken into consideration by healthcare professionals while identifying older adults with a risk of falls and designing fall prevention and management strategies in line with the current guidelines.

Declarations

Author contribution statement

Halima Saeed Alzaabi: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Lori Maria Walton: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Ashokan Arumugam: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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