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Prevalence and determinants of falls among elderly people in Makkah, Saudi Arabia

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ABSTRACT

Introduction: Falls are among the most damaging events to the elderly. In Makkah, Saudi Arabia, only one study has so far attempted to determine the prevalence of falls among elderly patients. Our goal was to ascertain the frequency and contributing factors of falls among elderly people in Makkah.
Methods: This cross-sectional study among the elderly in Makkah had a sample size of 383 participants. Questionnaires were completed by physicians and researchers through face-to-face interviews to ensure proper data collection.
Results: Of the 397 participants included, 53.1% were female. The incidence of falls was 47.4%. Individuals with an MAHC-10 score ≥ 4 represented 28.7% of the sample, and the prevalence of falls among them was 78.9%. In the multivariate binary logistic regression (BLR), an MAHC-10 score ≥ 4 was significantly associated with falls (OR = 10.36, 95% CI:5.69-18.88, $p<0.001$) compared with an MAHC-10 score < 4, adjusted for educational level and history of taking any medication regularly.
Conclusions: This study showed an elevated frequency of falls among the elderly in Makkah. Several factors were identified related to falls. Healthcare providers should conduct screenings to prevent falls. Conducting additional prospective research and introducing fall prevention programs for the elderly in Makkah is advisable.

Keywords
Falls; Prevalence; Elderly; Geriatrics; Public Health; Risk Factors; Saudi Arabia; Makkah.

Introduction

Falls are one of the most damaging events that can happen to an elderly person. (1) The World Health Organization (WHO) defines a fall as ‘an event which results in a person coming to rest inadvertently on the ground or floor or other lower level.’ (2) As a result of a fall, an elderly person can experience adverse consequences including disability, loss of independence, decreased daily functioning, and increased mortality. (3) Falls among the elderly account for approximately 40% of trauma-related deaths, 80% of hospitalisations, and 18-40% of emergency department visits. (4, 5) The definition of ‘older people’ varies according to the context and purpose of its use. Various organizations and countries define ‘old age’ differently so no universally agreed definition exists. (6) However, 65 years or older has been accepted by most developed countries as a definition of ‘elderly’ or ‘older person’.

Many risk factors cause falls in the elderly; these can be divided into intrinsic factors, extrinsic factors, and risk exposure. (7) Intrinsic factors include age, gender, living alone, having medical conditions, and receiving specific medications, impaired mobility and gait, foot problems, sedentary behaviour, physiological status like fear of falling, nutritional deficiency, cognitive impairment, visual impairment, and previous falls. (7) Extrinsic factors involve environmental hazards like slippery floors, uneven surfaces, and poor lighting. They include but are not limited to footwear, clothing, and inappropriate walking aids or assistive devices. (8, 9) Risk exposure can be

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applied to falls among the elderly by assessing the likelihood of falls and their potential negative outcomes. (10) Risk exposure, which represents the intersection between intrinsic and extrinsic factors, is controversial. (11) Lack of movement increases the severity of intrinsic factors while increasing physical activity increases the seriousness of extrinsic factors by increasing exposure to hazardous environmental conditions, fatigue, or risky exercise practices. (11,12) By addressing these risk factors, the risk of falls can be reduced, promoting safety and well-being in the elderly population.

According to a combined analysis of six studies from the Gulf region, 46.9% of people in the Gulf countries were estimated to have fallen at some point in their lives. The results revealed that falls were far more common in the senior population than in the general population. (13) The reported prevalence of falls in the older population was 57% in a study conducted in Saudi Arabia (14) and 34% in another study in Qatar. (15) According to a cross-sectional study done in Riyadh, 49.9% of Saudi seniors suffer falls, and 75% of those falls result in injuries. (18) Elderly people with low levels of education or those who reside in rental homes were more likely to fall. (16)

Due to rising living standards, the percentage of the elderly has sharply increased in Saudi Arabia over the past three decades, (17) emphasising the need to address health issues associated with ageing, notably falls. Moreover, many preventable healthcare expenses might be attributed to falls and their consequences. (18) A systematic review and meta-analysis demonstrated that exercise is a useful treatment for improving the static and dynamic balance of adults 65 years of age and older and can lower their risk of falling. (19) In addition, fall prevention programs should be implemented not just for patients undergoing rehabilitation but also for the general healthy population.

In Makkah, only one study was found that attempted to determine the prevalence of falls among elderly patients. (20) With a fall prevalence of 2.4%, this rate applied to hospitalised patients of all ages. (20) Therefore, estimates of the frequency of falls among the elderly in Makkah are necessary as they represent a high-risk population. Our goal was to ascertain the frequency and contributing factors of falls among elderly people in Makkah, Saudi Arabia.

Methods

This cross-sectional study was conducted from January to May 2024 among elderly people attending primary healthcare centres (PHCs) in Makkah. Inclusion criteria were people aged 65 years or older and living in Makkah, Saudi Arabia. Exclusion criteria were poor cognitive functions and mental illness as these may alter the ability to recall the fall accidents or otherwise cause unreliable responses.

The sample size was calculated at 383 participants, with a confidence level of 95%, 5% precision, and 0.05 error, based on an expected prevalence of 50%, which was reported in a previous study (16). This study used a two-stage sampling technique. A total of 82 PHCs are located in Makkah. For the study, PHCs were selected randomly from among those in each sector. The needed sample was proportionally allocated to each PHC according to the number of elderly people registered in the centre's coverage area. Participants were selected randomly from each PHC's list of patients in the second stage of randomisation.

The questionnaire on the predesigned online form was completed by physicians and researchers through face-to-face interviews in the clinics or phone calls to ensure proper data collection. The questionnaire consisted of three parts: The first part requested the demographic characteristics of

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the participants, the second was about their general health and past medical and surgical history, and the third included questions related to the occurrence and determinants of falls using the ten-item Missouri Alliance for Home Care (MAHC-10) fall risk assessment tool. (21) The original MAHC-10 score had a range of 0 to 10. However, due to the inclusion criteria allowing only participants aged 65 and older and the exclusion criteria excluding individuals with cognitive impairment, the minimum score for our participants was 1 and the maximum score was 9.

The dependent variable in this study was the history of falls in the last 12 months, while the independent variable was a MAHC-10 score ≥ 4 (high risk of falling). The questionnaire was previously validated in many studies conducted in Saudi Arabia. (22) However, to further test the clarity and validity of the questions, a pilot study recruited a convenience sample of 20 participants, and experts in the field of public health and epidemiology reviewed their responses. Furthermore, the difficulties and the time required to finish the questionnaire were revised. The responses in the pilot study were not included in the final analysis of the study.

Data were analysed using the SPSS version 26.0. Descriptive and inferential analyses of the data were conducted to investigate the association between falls and their risk factors. To describe, summarise and report the data, descriptive analysis was used, while inferential statistics were used to identify significantly associated risk factors with falls. The Chi-square test and BLR were used to test the association of all the variables with the dependent variable. Potential confounders were identified using the univariate BLR to define the regression coefficients, p-values, odds ratios (ORs) and 95% CI. Multivariate BLR analysis was used to model the relation of falls with the significant risk factors while accounting for confounders. The statistically significant level of <0.05 for p-value was used.

We obtained ethical approval for this study from the Institutional Review Board, Security Forces Hospital Program in Holy Capital, Makkah, Saudi Arabia (0642-270923). Data confidentiality was maintained, and the data were used only for this study. Participation in the study was voluntary and verbal informed consent was obtained at the beginning of the interview after the aims and objectives of the study were clearly explained. We received no grants from funding agencies for this self-funded research.

Results

The study included a total of 397 participants from various communities in Makkah. The majority (53.1%) of the participants were female. The age distribution of the participants was as follows: 37.0% were aged 65-70, 29.2% were aged 71-75, 20.4% were aged 76-80, 9.8% were aged 81-85, and only 3.5% were aged over 85 years old. The majority (63.5%) of the participants were married. Single individuals comprised 10.6% of the total, divorced individuals accounted for 12.1%, and widowed individuals represented 13.9%. Only 10.3% of the participants possessed a bachelor's degree or a higher level of education. Over two-fifths (44.1%) of the participants were non-smokers, 32.0% were former smokers, and 23.9% were current smokers. A small proportion of the participants, specifically 11.8%, engaged in regular exercise one to two times per week. An even smaller percentage, 7.3%, exercised more frequently, at least three times per week. In contrast, nearly half of the participants (42.8%) did not exercise at all, while 38.0% exercised rarely. Table 1 presents comprehensive demographic information.

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Table 1: Demographic features among study participants and their relationship with prevalence of fall in the last 12 months

Variable	Category	n	Percent	Falls prevalence		P value*
				n	Percent	
Age	65-70	147	37.0	68	46.3	0.29
	71-75	116	29.2	49	42.2	
	76-80	81	20.4	39	48.1	
	81-85	39	9.8	24	61.5	
	>85	14	3.5	8	57.1	
Gender	Male	186	46.9	82	44.1	0.22
	Female	211	53.1	106	50.2	
Marital status	Single	42	10.6	18	42.9	0.89
	Married	252	63.5	119	47.2	
	Divorced	48	12.1	23	47.9	
	Widowed	55	13.9	28	50.9	
Nationality	Saudi	300	75.6	149	49.7	0.11
	Non-Saudi	97	24.4	39	40.2	
Educational level	Illiterate	44	11.1	23	52.3	<0.001
	Elementary	75	18.9	35	46.7	
	Intermediate	99	24.9	53	53.5	
	Secondary	90	22.7	50	55.6	
	Diploma	48	12.1	22	45.8	
	Bachelor’s or higher	41	10.3	4	12.2	
Monthly income	<3,000 SAR	123	31.0	59	48.0	0.001
	3,000-6,000 SAR	200	50.4	108	54.0	
	6,000-12,000 SAR	40	10.1	15	37.5	
	>12,000 SAR	34	8.6	6	17.6	
Geographical area	Rural	34	8.6	14	41.2	0.57
	Suburban	145	36.5	73	50.3	
	Urban	218	54.9	101	46.3	
Home ownership	Rented	193	48.6	95	49.2	0.009
	Family-Owned	52	13.1	33	63.5	
	Owned	152	38.3	60	39.5	
Smoking status	Never smoke	175	44.1	82	46.9	0.92
	Quit smoking	127	32.0	62	48.8	
	Current Smoker	95	23.9	44	46.3	
Exercising	No	170	42.8	92	54.1	0.019
	Rarely	151	38.0	69	45.7	
	1-2 times per week	47	11.8	20	42.6	
	3 or more times per week	29	7.3	7	24.1	

*P value of the chi-square analysis between each variable and the history of falls in the last 12 months (prevalence of fall).

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The incidence of falls among the participants in our study was 47.4%. Most of the participants had a medical history involving at least one chronic disease (57.7%) and were consistently taking at least one medication (60.2%). The history of falls was significantly associated with both variables, with rates of 52.0% ($\chi^2 = 4.61$, $p = 0.032$) and 51.5% ($\chi^2 = 4.07$, $p = 0.044$), respectively. The participants had a prevalence rate of 31.5% for obesity and 37.8% for overweight. Our study found no statistically significant association between body mass index (BMI) and falls. Of the individuals with an MAHC-10 score ≥ 4, which indicates a high risk of falling, 28.7% were found to be at risk, and the prevalence of falls among this group was 78.9%. On the other hand, of the participants with an MAHC-10 score < 4, 71.3% were not at risk, and only 34.6% had a history of falling ($\chi^2 = 64.02$, $p<0.001$), (Table 2).

Table 2: Prevalence of fall, other contributing factors, and MAHC-10 score and its components and their relation to history of fall in the last 12 months

Variable	Category	n	%	Prevalence of fall		P value*
				n	%	
Overall				188	47.4	
At least 1 chronic disease	Yes	229	57.7	119	52.0	0.032
	No	168	42.3	69	41.1	
Taking medication regularly	Yes	239	60.2	123	51.5	0.044
	No	158	39.8	65	41.1	
BMI	Normal	122	30.7	56	45.9	0.580
	Overweight	150	37.8	68	45.3	
	Obese	125	31.5	64	51.2	
MAHC-10 score ≥ 4	Yes	114	28.7	90	78.9	<0.001
	No	283	71.3	98	34.6	
Comorbidities (>3 medical diagnoses)	Yes	130	32.7	86	66.2	<0.001
	No	267	67.3	102	38.2	
Falls within 3 months	Yes	73	18.4	73	100.0	<0.001
	No	324	81.6	115	35.5	
Incontinence	Yes	125	31.5	84	67.2	<0.001
	No	272	68.5	104	38.2	
Visual impairment	Yes	127	32.0	84	66.1	<0.001
	No	270	68.0	104	38.5	
Impaired functional mobility	Yes	63	15.9	50	79.4	<0.001
	No	334	84.1	138	41.3	
Environmental hazards	Yes	76	19.1	55	72.4	<0.001
	No	321	80.9	133	41.4	
Polypharmacy (≥4 concurrent medications)	Yes	80	20.2	57	71.3	<0.001
	No	317	79.8	131	41.3	
Pain affecting level of function	Yes	67	16.9	47	70.1	<0.001
	No	330	83.1	141	42.7	

*P value of the chi-square analysis between each variable and the history of falls in the last 12 months (prevalence of fall).

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Table 3 shows the results of the univariate analysis using BLR of the dependent variable, the history of falls in the last 12 months, against the MAHC-10 score ≥ 4 (high risk of falling) as the main independent variable and all other variables that were significantly associated with the dependent variable that were discovered using the Chi-square test (Tables 1 and 2). An MAHC-10 score ≥ 4 was significantly associated (p<0.001) with increasing the odds of having a history of falls in the last 12 months by seven times (OR = 7.08, 95% CI:4.24-11.82) compared with an MAHC-10 score < 4. The only educational level significantly associated with falls was a bachelor's degree or higher (p<0.001), which decreases the odds of having a history of falls in the last 12 months by 87% (OR = 0.13, 95% CI: 0.04-0.38) compared with being illiterate. 'Exercising three or more times per week' was significantly associated (p = 0.004) with decreased odds (73%) of having a history of falls in the last 12 months (OR = 0.27, 95% CI: 0.11-0.67) compared with 'not exercising at all.' Also, a monthly income of more than SAR 12,000 was significantly associated (p = 0.003) with decreased odds (77%) of having a history of falls in the last 12 months (OR = 0.23, 95% CI: 0.09-0.60) compared with an income of less than SAR 3,000 monthly. Participants living in family-owned houses were about three times as likely to have a history of falls in the last 12 months (OR = 2.66, 95% CI: 1.39-5.11, p = 0.003) as participants living in their own houses. Having at least one chronic disease was significantly associated (p = 0.032) with increased odds (55%) of having a history of falls in the last 12 months (OR = 1.55, 95% CI: 1.04-2.32) compared to not having any chronic diseases. Taking at least one medication regularly was also significantly associated (p = 0.044) with increased odds (51%) of having a history of falls in the last 12 months (OR = 1.51, 95% CI: 1.01-2.28) compared to not having any chronic diseases.

Table 3: Univariate BLR of significant associated factors with history of fall in the last 12 months

Variable	Category	OR*	95% CI	P value
MAHC-10 score ≥ 4 (High risk of fall)	Yes	7.08	4.24-11.82	<0.001
	No	Ref		
Education level	Illiterate	Ref		
	Elementary	0.89	0.38-1.68	0.555
	Intermediate	1.05	0.52-2.14	0.889
	Secondary	1.14	0.55-2.35	0.720
	Diploma	0.77	0.34-1.75	0.537
	Bachelor's or higher	0.13	0.04-0.38	<0.001
Exercising	No	Ref		
	Rarely	0.71	0.46-1.11	0.132
	1-2 times per week	0.63	0.33-1.21	0.162
	3 or more times per week	0.27	0.11-0.67	0.004
Monthly income	<3,000 SAR	Ref		
	3,000-6,000 SAR	1.27	0.81-2.00	0.292
	6,000-12,000 SAR	0.65	0.31-1.35	0.250
	>12,000 SAR	0.23	0.09-0.60	0.003
Home ownership	Rented	1.49	0.97-2.29	0.071
	Family-Owned	2.66	1.39-5.11	0.003

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	Owned	Ref		
Chronic disease	Yes	1.55	1.04-2.32	0.032
	No	Ref		
Taking medication regularly	Yes	1.51	1.01-2.28	0.044
	No	Ref		

*Crude OR.

In the multivariate BLR of having a history of falls in the last 12 months as an outcome variable (Table 4), the final model includes an MAHC-10 score ≥ 4, educational level and taking medication regularly. All variables in Table 3 were included in the initial analysis, but home ownership, monthly income, exercising, and chronic diseases were then removed one by one, as they were not statistically significant in the model. The main effect was for the independent variable of interest, which showed that an MAHC-10 score ≥ 4 was significantly associated ($p<0.001$) with more than ten times greater odds of having a history of falls in the last 12 months (OR = 10.36, 95% CI:5.69-18.88) compared with an MAHC-10 score < 4, adjusted for educational level and history of taking medication regularly.

Table 4: Final BLR model of the association between history of fall in the last 12 months and MAHC-10 score ≥ 4, adjusted for educational level and taking medication regularly

Variable	Category	OR*	95% CI	P value
MAHC-10 score ≥ 4 (High risk of fall)	Yes	10.36	5.69-18.88	<0.001
	No	Ref		
Education level	Illiterate	Ref		
	Elementary	1.17	0.50-2.71	0.720
	Intermediate	1.32	0.59-2.95	0.502
	Secondary	1.08	0.48-2.47	0.848
	Diploma	0.87	0.34-2.22	0.777
	Bachelor's or higher	0.08	0.02-0.26	<0.001
Taking medication regularly	Yes	1.88	1.17-3.03	0.009
	No	Ref		

*Adjusted OR.

Discussions

To the best of our knowledge, this is the first study in Makkah to assess the prevalence of falls among adults aged 65 and older in community settings. The findings of this study provide insight into the prevalence and risk factors of falls. They also contribute significantly to the current literature on geriatric health by offering valuable insights into the complex characteristics of falls in this critical age group. The frequency of falls among our participants is comparable with other studies conducted in Saudi cities. (16,23-25) This demonstrates the similarity of Makkah's elderly population to other parts of the country. In addition, the rates observed in our study and other studies conducted in Saudi Arabia were higher than the global prevalence of falls among older individuals, which was reported to be 26.5% in a systematic review of 104 studies involving a total

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of 36,740,590 participants. (26) This emphasises the significant impact of falls in Saudi Arabia. The importance of falls as a health problem for the elderly is highlighted, in line with current worldwide trends that acknowledge falls as a big public health issue for the elderly that requires significant prevention programs. (27)

In terms of fall-related demographics, our study found no association between falls and different age groups of older adults. This unexpected conclusion was nonetheless consistent with earlier studies conducted on the same age range of 65 and older in Saudi Arabia's capital. (16) This leads us to several conclusions, the first of which is that the incidence of falls rises dramatically beyond the age of 65 and does not vary much thereafter, regardless of age. This could also be because severe ageing impairs a person's movement, lowering their chance of falling. On the other hand, Alqurayshah et al. (28) and Alabdullgader and Rabbani (22) found that falls increased significantly with age. Furthermore, our study showed no notable disparity between males and females in the occurrence of falls within the past 12 months. This aligns with the findings of a study conducted in Tabuk City, which also concluded that gender is not significantly related to falls. (29)

In the current study, educational level was not substantially connected with falls, except for participants with a bachelor's degree or higher, who were statistically significantly less likely to fall than illiterates. That was consistent with the findings of other local studies. (16,22) Also, monthly income was significantly related to falls, consistent with a recent study among the community-dwelling Korean elderly. (30) This finding is not surprising given that poor older people are more vulnerable to environmental hazards and have less access to education and health promotion programs, raising the risk of developing chronic diseases, physical disability, and falls. In the same context, lack of exercise was found to have a statistically significant relationship with falling. This finding is consistent with the results of a previous study, which found that limited mobility was an important risk factor for falls among the elderly. (31) However, safety must be stressed in exercise for the elderly, as physical activity is recognised as a risk factor for falls among the elderly.

In our sample, the presence of at least one chronic condition was strongly linked to a history of falling within the past 12 months, with a prevalence rate of 52.0%. The prevalence of falls among individuals with three or more chronic conditions increased to 66.2%. This finding was expected due to the physiological health affected by chronic disorders, which could be a contributing factor. An analysis of 16,357 elderly persons in Canada showed that those who had no chronic conditions experienced a notably lowered likelihood of falling in comparison to those who had any chronic condition. (32) Additionally, the likelihood of experiencing a fall rose in tandem with the number of chronic illnesses, as seen in a study examining the correlation between chronic diseases and falls among elderly individuals in Finland. (33) Our study found that chronic medication usage was associated with an elevated risk of falls in the previous 12 months. This risk was particularly high for individuals on polypharmacy (four or more medications), with the prevalence of falls rising dramatically from 51.5% for those regularly using one to three medications to 71.3% for those on polypharmacy. Consistent with other research, the correlation between medication use and falls is notable, particularly in cases of polypharmacy. In contrast, we found no significant correlation between BMI and fall history. No significant difference was found in the occurrence of falls in the past 12 months among people who were obese, overweight, or normal weight. This is similar to the outcome of a regional study conducted among the elderly population of Unaizah. (22) However, discrepancies in the research findings regarding the correlation between BMI and the likelihood of experiencing a fall have also been observed.

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Multiple studies have identified a direct relationship between BMI and incidents of falls in elderly individuals. (34) In certain cases, a higher BMI was associated with a reduced probability of falls among newly admitted patients in nursing homes. (35)
The MAHC-10 is a validated multifactorial assessment tool for detecting fall risk that is suitable for all patients, including those who are bedridden or have significant mobility impairments. (21) In our study, MAHC-10 appeared to be a useful fall risk screening tool, capable of identifying those at risk of falling at the current recommended cut-off score of 4. The prevalence of falls in the previous 12 months was 78.9% among high-risk participants, compared to 34.6% among low-risk participants, which was identified using the MAHC-10 cut-off point of 4. Participants having a history of falls were seven times more likely to be at high risk than those without a history of falls ($p<0.001$). This finding is comparable with the conclusions of other local research, which found MAHC-10 to be strongly related to a history of falls (14,22,29), demonstrating the validity of the MAHC-10 as a fall risk assessment tool among Saudi Arabia's older population.

Conclusion

This study showed an elevated frequency of falls among elderly patients who visit PHCs in Makkah. Several variables were identified as significantly associated with the risk of falling, including educational level, degree of physical activity, presence of chronic diseases, medication usage, and environmental factors. The MAHC-10 is an effective tool for screening fall risk using the current recommended cut-off score of 4. Healthcare providers should conduct screenings for these risk factors in elderly patients and offer specific advice and care to prevent falls. Conducting additional prospective research on a larger scale is advisable to further assess the risk factors associated with falls. Furthermore, fall prevention strategies and programs for the elderly population living in Makkah, Saudi Arabia must be introduced and executed.

Limitations and Future Studies

Although this research provides valuable insights into the prevalence and risk factors of falls among the geriatric population in Makkah, certain limitations must be acknowledged. The subjects of the study, persons seeking care at PHCs, may introduce selection bias as they may differ significantly from those who do not use healthcare services or those who have mobility constraints. Certain variables were omitted from the data collection form to prevent participant questionnaire fatigue and to ensure a high participation rate. The cross-sectional study design imposes a constraint on establishing causation due to its ability to capture a momentary view of the health status of the participants. Furthermore, this type of design is prone to potential deficiencies in participants' recollection of incidents or inaccurate reporting of specific details, which could compromise the accuracy of the findings. Prospective study design might offer a more precise understanding of the

temporal relationships between falls and various risk factors and reduce the possibility of recall bias.

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