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# Moving the needle on implementing fall prevention programs in Saudi Arabia: assessing knowledge and perceptions of fall risk among community-dwelling older women

Maha Almarwani<sup>1\*</sup>

## Abstract

**Background** Saudi Arabia, like many nations globally, is experiencing a demographic shift towards an aging population. With this demographic shift, falls and the fear of falling (FOF) emerge as serious public health concerns among community-dwelling older adults. Addressing misconceptions and enhancing awareness regarding fall risks among older adults holds significant importance, offering insights for informing targeted interventions and enhancing well-being. This study aimed to examine knowledge and perceptions of fall risk among community-dwelling older women in Saudi Arabia.

**Methods** A cross-sectional study was conducted with 150 Saudi older women, with a mean age (SD) of 63.98 (4.90) years. Participants completed questionnaires assessing fall history, fall knowledge, fall perception, the Falls Efficacy Scale-International (FES-I), Timed Up and Go (TUG), and the Barthel Index. Fall knowledge and perception were assessed using previously constructed statements translated into Arabic and carried out in interviewer-administered forms.

**Results** Nearly half of the participants reported experiencing at least one fall in the previous 12 months. Despite good knowledge of falls, some gaps were identified, particularly regarding the awareness of social isolation as a consequence of falls. Participants demonstrated positive perceptions towards fall prevention programs but also highlighted misconceptions regarding aging and falls. FOF was prevalent, with higher levels identified among participants without a history of falls.

**Conclusion** Multidimensional strategies are needed to address falls and FOF among community-dwelling older women in Saudi Arabia. Leveraging existing knowledge and perceptions towards fall prevention and implementing evidence-based interventions can reduce the burden of falls and enhance health outcomes in older adults. Future research should focus on diverse samples and evaluate the feasibility of implementing fall prevention interventions within Saudi Arabia's healthcare systems.

**Keywords** Knowledge, Perception, Fear of falling, Community-dwelling, Older women

This work was supported by the Research Center of the Female Scientific and Medical Colleges, Deanship of Scientific Research, King Saud University, Riyadh, Saudi Arabia.

\*Correspondence:

Maha Almarwani  
malmarwani@ksu.edu.sa

Full list of author information is available at the end of the article



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## Background

The numbers and proportion of older adults are increasing worldwide each year [1]. Saudi Arabia is currently approaching uncharted territory in terms of the proportion of its aging population and the need for this population. Recent data show that there has been a significant change in Saudi Arabia's age structure owing to the fall in birth rates of the Saudi population and the increase in life expectancy [1, 2]. Projections suggest that by 2050, nearly 18.4% of Saudi Arabia's population of 40 million will be aged 65 and above [1].

Falls among community-dwelling older adults constitute a significant public health concern worldwide, with prevalence rates ranging from 20 to 45% annually [3–5]. Falls and fall-related injuries constitute a critical and rising public health problem, as evidenced by the Centers for Disease Control and Prevention national initiative, Stopping Elderly Accidents, Deaths, and Injuries (STEADI) [6]. Falls often restrict mobility, limit physical activity, and reduce quality of life, resulting in significant social and economic burdens [7]. Falls may also increase fear of falling (FOF) [8]. Fear of falling can exacerbate these consequences, leading to physical decline, depression, social isolation and further physical deterioration [9]. Fear of falling develops in approximately 20% to 39% of older adults after a fall. Therefore, falls and FOF can reinforce one another and cause frailty through activity avoidance, mobility restriction [10], limitations in living space [11], and severe declines in the quality of life [12]. Risk factors for falls among older adults are multifactorial, including complex interactions of biological, behavioral, environmental, and socioeconomic factors [13]. Women have a higher risk of falling than men. Women are 2.2 times more likely to suffer a fall-related fracture and display a hospitalization rate 1.8 times higher than men, resulting in higher health care costs [14].

There is strong evidence that falls can be prevented. Falls prevention and education programs that target risk factors for falls and fear of falling can reduce the rate of falls, the risk of fall-related injuries, and enhanced self-efficacy among older adults [15–17]. The American and British Geriatrics Societies (AGS/BGS) Clinical Practice Guidelines recommend that health care providers, including physical therapists, use a multicomponent approach that includes training program with various combinations of balance, endurance, gait, flexibility, and physical function training [18]. Social support, exercise training programs, knowledge and perception were found to influence adherence to fall prevention programs [19, 20].

In Saudi Arabia, the prevalence of at least one fall in the last 12 months among older adults ranges from 31.6% up to 57.7% [21–23]. To date, limited research in Saudi

Arabia has been devoted to studying falls and fall-related sequelae among older adults, despite the high prevalence of falls among older adults. We still face the challenge of a lack of national estimates of falls and fall-related injuries for older adults in Saudi Arabia. The findings of this study could help provide evidence for the process of developing a national fall profile and can be used to develop resources to improve fall risk awareness among older adults in Saudi Arabia. Therefore, the aim of this study was to examine knowledge and perceptions of fall risk among community-dwelling older women in Saudi Arabia.

## Methods

### Study design and participants

This cross-sectional study was conducted at the King Salman Social Center in Riyadh, Saudi Arabia. We included a convenience sample of 150 volunteer community-dwelling Saudi older women who responded to our invitation poster after undergoing eligibility screening. The inclusion criteria were 60 years of age and older, self-reported ability to independently walk a household distance (approximately 50 ft) at a minimum, with or without an assistive device, and without the assistance of another person. Also, they had to be free of (a) cancer with active treatment (specifically radiation or chemotherapy) within the past 6 months; (b) non-elective hospitalization for a life-threatening illness or major surgical procedure in the past 6 months; (c) severe pulmonary disease requiring supplemental oxygen or resulting in difficulty breathing at rest or with minimal exertion (such as walking between rooms in their home); (d) chest pain with activity or a cardiac event, such as a heart attack, within the past 6 months; and (e) inability to discuss the study content after reviewing the consent form. These eligibility criteria were established to ensure that participants could actively take part in the study.

The sample size of participants was estimated through a priori power analysis using G\*power (v.3.1.9.7), with a statistical power of 95%, a two-tailed alpha of 0.05, and an effect size of 0.3 [24]. The minimum sample size for this study was calculated to be 134. To account for potential dropouts, we invited more participants than the minimum required.

This study was approved by the College of Medicine Institutional Review Board at King Saud University (E-19–3728), and all participants provided informed consent prior to participation.

### Outcome measures

#### Fall history

A definition of fall was determined as unintentionally coming to rest on the ground, floor, or a lower level

[25]. In the current study, the number of falls within the 12-month was recorded for each participant.

#### Fall knowledge and fall perception

Fall knowledge was assessed using 15 statements translated into Arabic in an interviewer-administered type of questionnaire described in Gamage, N.'s paper in 2018 that was based on the fall risk factors described by WHO under the four categories of biological, environmental, behavioral, and socioeconomic factors. It includes statements about diseases that increase the risk of falling, the consequences of falling and preventive methods. For each statement, if they answered "known", it is scored 5 or "unknown", which is scored 0. The maximum score is 75, and zero is the minimum score. Final scores are categorized into 3 groups: "poor knowledge" if scored from 0–25, "average knowledge" if scored from 26–50 and "good knowledge" for those who scored 51–75 [26].

Fall perception was assessed using eight statements, three of which were negatively expressed and five were positively expressed. These statements were used in previous studies to assess fall perception among older adults, including the Gamage, N. et al. study in 2018 [26, 27]. The data is presented on a five-point Likert scale from 5 to 1. On the positive statements, 5 was given for 'strongly agree' down to 1 for 'strongly disagree'. Conversely, on the negative statements, 5 was given for 'strongly disagree' and 1 for 'strongly agree'. Total scores ranged from 8 to 45, with scores from 8 to 18 considered 'negative perception' and those from 19 to 45 considered 'positive perception' [26].

The fall knowledge and fall perception questionnaire items underwent a rigorous translation process from English into Arabic following the Beaton guidelines to ensure linguistic and cultural equivalence [28]. Subsequently, a pilot test was conducted with 25 older adults to assess the clarity, relevance, and effectiveness of the questionnaire items. Participants provided positive feedback, indicating the questionnaire's clarity and ease of completion without any issues being raised. The internal consistency of the questionnaires was good, with Cronbach's alpha coefficients of 0.88 for knowledge items and 0.78 for perception items.

#### Falls Efficacy Scale-International (FES-I)

The Arabic version of FES-I was used to evaluate fall self-efficacy. FES-I measures the level of concern about falling during 16 social and physical activities, ranging from simple to more demanding activities, whether or not the individual actually does the activity. The level of concern for each item is measured on a 4-point scale (1=not at all concerned to 4=very concerned). A total score range is 16–64, and the higher score indicates more concern

about falls. The Arabic-validated version of the 16-item FES-I is valid and reliable among older adults (Cronbach's  $\alpha=0.92$ ) [29].

#### The Timed Up and Go (TUG)

The TUG was used to examine functional mobility and dynamic balance. The TUG test involved participants' getting up from a chair, walking 3 m at a comfortable speed, turning around, walking back to the chair, and sitting down. The time in seconds was recorded between when the examiner verbalized "go" and when the participant's back touched the backrest of the chair. The average of the two experimental trials was used in the analysis [30]. TUG is a valid and reliable test for screening functional mobility in community-dwelling older adults (ICC=0.99) [30]. A TUG score of 14 is sensitive (87%) and specific (87%) for identifying older individuals who are at risk for falls [31].

#### Barthel index

The Barthel Index was used to measure performance in activities of daily living (ADL) using 10-statements [32]. The total score ranges from 0 to 100. If the summed score is 0, it indicates total dependence, while 100 indicates full independence. Each statement assesses the patient's performance in ADL as to whether they are independent, need some assistance, or are dependent on others' help based on observation. The Barthel index is reliable and valid for measuring changes in physical function among older adults (ICC=0.96) [33].

#### Statistical analysis

All statistical analyses were performed using SPSS ver. 27.0 (SPSS, Inc., Chicago, IL, USA). We computed appropriate descriptive statistics to describe the study participants. Means and standard deviations were reported for continuous variables, while frequency and percentage were used for categorical variables. Chi-squares and an independent t-test were performed to examine the group differences in the demographic and health-related variables with and without a fall history. The chi-square test was for categorical variables, while the t-test was used for continuous variables. The level of statistical significance was set at  $p<0.05$ .

## Results

### Participants

Participant characteristics are shown in Table 1. A total of 150 community-dwelling older women ( $63.98 \pm 4.90$  years) participated in the study. Among the participants, 33.3% ( $n=50$ ) were not educated, whereas 30.7% ( $n=46$ ) had only primary education. The average number of chronic health conditions reported was  $1.48 \pm 1.21$ .

**Table 1** Characteristics of participants ( $n = 150$ )

| Variable  | Total         | Non-Fallers ( $n = 78$ ) | Fallers ( $n = 72$ ) | P value |
|---|---------------|--------------------------|----------------------|---------|
| <b>Demographic variables</b>                                  |               |                          |                      |         |
| Age (years)   | 63.98 ± 4.90  | 63.28 ± 4.56             | 64.74 ± 5.20         | 0.069   |
| BMI (kg,m <sup>2</sup> )                                      | 31.69 ± 5.32  | 32.60 ± 4.8              | 30.70 ± 5.7          | 0.031*  |
| <b>Marital status</b>   |               |                          |                      |         |
| Single  | 2 (1.3%)      | 1 (1.3%)                 | 1 (1.4%)             | 0.362   |
| Married   | 91 (60.7%)    | 48 (61.5%)               | 43 (59.7%)           |         |
| Divorce   | 6 (4%)        | 1 (1.3%)                 | 5 (6.9%)             |         |
| Widow   | 51 (34%)      | 28 (35.9%)               | 23 (31.9%)           |         |
| <b>Level of education (years of study)</b>                    |               |                          |                      |         |
| Not educated  | 50 (33.3%)    | 22 (28.2%)               | 28 (38.9%)           | 0.031*  |
| Elementary  | 46 (30.7%)    | 28 (35.9%)               | 18 (25.0%)           |         |
| Middle school   | 11 (7.3%)     | 3 (3.8%)                 | 8 (11.1%)            |         |
| High school   | 18 (12%)      | 7 (9.0%)                 | 11 (15.3%)           |         |
| Higher education  | 25 (16.7%)    | 18 (23.1%)               | 7 (9.7%)             |         |
| <b>Health-related variables</b>                               |               |                          |                      |         |
| Number of chronic health conditions                           | 1.48 ± 1.21   | 1.40 ± 1.15              | 1.37 ± 1.08          | 0.915   |
| <b>Falls Efficacy Scale International (FES-I)</b>             | 47.99 ± 14.08 | 48.85 ± 13.60            | 47.07 ± 14.63        | 0.442   |
| <b>Falls Efficacy Scale International (FES-I) categories:</b> |               |                          |                      |         |
| Low FOF concern   | 4 (2.7%)      | 1 (1.3%)                 | 3 (4.2%)             | 0.542   |
| Moderate FOF concern  | 8 (5.3%)      | 4 (5.1%)                 | 4 (5.6%)             |         |
| High FOF concern  | 138 (92%)     | 73 (93.6%)               | 65 (90.3%)           |         |
| TUG (s)   | 13.51 ± 4.85  | 13.60 ± 5.50             | 13.45 ± 4.06         | 0.888   |
| Barthel index   | 97.83 ± 5.86  | 98.01 ± 6.15             | 97.64 ± 5.56         | 0.698   |

The number of chronic health conditions is self-reported and includes diagnosed chronic conditions such as hypertension, diabetes mellitus, cardiovascular disease, pulmonary disease, arthritis, and osteoporosis

Abbreviations: BMI Body Mass Index, TUG Timed Up and Go, FES-I Falls Efficacy Scale International, FOF Fear of Falling

\* Significant  $p$ -values < 0.05; independent  $t$ -test was used for continuous variables, while Chi-square test was used for categorical variables

Approximately half of participants reported having experienced at least one fall during the previous 12-month 48% ( $n = 72$ ). The majority of the participants, 92% ( $n = 138$ ) reported having a high concern about falling, and the average score of FES-I was  $47.99 \pm 14.08$ . No significant difference was identified between older women with a history of falls and without a history of falls in all demographic and health status variables except in BMI and level of education ( $p < 0.05$ ) (Table 1).

### Fall knowledge

The majority of participants demonstrated "good knowledge" ( $n = 135$ ; 90%) about falls and fall prevention, as shown in Table 2. Regarding awareness of the consequences of falls, most participants ( $n = 146$ ; 97.3%) were knowledgeable about at least two locations that are commonly fractured due to falls. However, some participants ( $n = 33$ ; 22%) were unaware that social isolation is one of the consequences of falls. Additionally, a smaller percentage exhibited "average knowledge" ( $n = 10$ ; 6.7%), while only a few showed "poor knowledge" ( $n = 5$ ; 3.3%).

### Fall perception

Perceptions regarding falls and fall prevention are presented in Table 3. Among participants, 38.7% strongly disagreed with the statement that falling is a normal consequence of being old and nothing can be done about it, while 28.7% strongly agreed. Additionally, 87% of participants strongly agreed that intervention after falls can prevent future falls, and 83% strongly agreed that addressing medical conditions correctly is very important for preventing falls.

### Discussion

This study is the first to examine knowledge and perceptions of fall risk among community-dwelling older women in Saudi Arabia. Despite participants having good knowledge and positive perceptions towards fall prevention programs, the study revealed a high prevalence of falls (48%) and fear of falling (92%), highlighting the complexity of the issue. Possible contributing factors to participants' high fear of falling may include fall-related self-efficacy [34], fall history, fall-related injuries [35], and individual perceptions of falls [36]. Environmental

**Table 2** Knowledge of falls and fall prevention among older women in Saudi Arabia ( $n = 150$ )

| Statement   | Known      | Not known |
|---|------------|-----------|
| Falls and related injuries are the leading cause of hospital admission among elderly people       | 139 (92.7) | 11 (7.3)  |
| Proper nutrition is very important to protect from falls  | 139 (92.7) | 11 (7.3)  |
| Exercise and active lifestyle reduce the chances of falls   | 143 (95.3) | 7 (4.7)   |
| Following medical advice helps to minimize the chances of falls due to side effects of medication | 138 (92.0) | 12 (8.0)  |
| Good lighting reduces the risk of falls   | 140 (93.3) | 10 (6.7)  |
| Aware of at least two commonest sites for fall related fractures                                  | 146 (97.3) | 4 (2.7)   |
| Aware of at least two food items, which are helpful for healthy bones                             | 140 (93.3) | 10 (6.7)  |
| Aware of medical conditions, which increase the risk of falls:                                    |            |           |
| a- Hypertension   | 137 (91.3) | 13 (8.7)  |
| b- Diabetes mellitus  | 138 (92.0) | 12 (8.0)  |
| c- Arthritis  | 130 (86.7) | 20 (13.3) |
| d- Ischemic heart disease   | 132 (88.0) | 18 (12.0) |
| Aware of the consequences of falls:   |            |           |
| a- Reduced mobility   | 141 (94.0) | 9 (6.0)   |
| b- Restriction of day today activities  | 139 (92.7) | 11 (7.3)  |
| c- Social isolation   | 117 (78.0) | 33 (22.0) |
| d- Depression   | 125 (83.3) | 25 (16.7) |

Data are presented as frequency and percentage

**Table 3** Perception of falls and fall prevention among older women in Saudi Arabia ( $n = 150$ )

| Statement   | Strongly agree | Agree     | No idea  | Disagree  | Strongly disagree |
|---|----------------|-----------|----------|-----------|-------------------|
| Older people fall and there is nothing that can be done to prevent falls                                | 45 (28.7)      | 16 (10.7) | 21 (14)  | 24 (16)   | 46 (38.7)         |
| It is not possible for me to fall and get injured or fractured  | 15 (10)        | 14 (9.3)  | 24 (16)  | 43 (28.7) | 54 (36)           |
| I do not worry about falling and getting injured  | 29 (19.3)      | 37 (24.7) | 10 (6.7) | 28 (18.7) | 46 (30.7)         |
| The safety of my house is very good for preventing falls  | 106 (70.7)     | 23 (15.3) | 10 (6.7) | 7 (4.7)   | 4 (2.7)           |
| I am weak and need to follow fall prevention activities   | 40 (26.7)      | 29 (19.3) | 14 (9.3) | 20 (13.3) | 47 (31.3)         |
| The intervention given after first fall can prevent recurrent falls                                     | 96 (64)        | 26 (17.3) | 15 (10)  | 5 (3.3)   | 8 (5.3)           |
| Carrying out knowledge training programmes on fall induced injury in the community is a great necessity | 118 (78.7)     | 17 (11.3) | 8 (5.3)  | 2 (1.3)   | 5 (3.3)           |
| Paying attention to correct my medical conditions is very important to get rid of falls                 | 125 (83.3)     | 10 (6.7)  | 10 (6.7) | 0 (0.0)   | 5 (3.3)           |

Data are presented as frequency and percentage

factors and chronic conditions have also been identified as related to a high fear of falling [37, 38]. Further investigation into the interplay among older adults in Saudi Arabia, including cultural beliefs, societal norms, and individual physical function, can provide a deeper understanding of the reasons behind participants' high fear of falling despite their substantial knowledge about fall prevention.

The findings regarding participants' knowledge of falls and fall prevention reveal both encouraging trends and areas for improvement. It is promising to note that the majority of participants demonstrated awareness of various fall-related statements, indicating a foundational understanding of fall risks and preventive measures.

Particularly noteworthy is the high level of awareness regarding the consequences of falls, with the majority of participants able to identify common fracture locations. However, the relatively lower awareness of social isolation as a consequence of falls among a subset of older women highlights a potential gap in knowledge that warrants attention. Previous studies highlight the intricate interplay between falls and social dynamics, particularly feelings of loneliness and social exclusion [39, 40]. Addressing these gaps through targeted education and awareness initiatives could further enhance the effectiveness of fall prevention efforts.

Moreover, the distribution of knowledge levels among participants, with the majority categorized as having

"good knowledge" suggests a generally positive baseline understanding within the study population. This underscores the potential for leveraging existing knowledge to reinforce and expand upon fall prevention strategies. Overall, these findings underscore the importance of continuous education and awareness initiatives to empower older adults with comprehensive knowledge of falls and fall prevention, ultimately contributing to improved health outcomes and quality of life in older populations.

The results concerning participants' perceptions of falls and fall prevention provide valuable insights into attitudes and beliefs surrounding this critical issue. It is encouraging to note that a considerable proportion of participants strongly disagreed with the notion that falling is an inevitable consequence of aging, indicating a rejection of fatalistic attitudes towards falls among this demographic. This indicates that older adults are willing to challenge stereotypes and adopt proactive approaches to fall prevention [41].

Furthermore, the high levels of awareness regarding the effectiveness of interventions after falls and the importance of managing medical conditions to mitigate fall risk underscore the recognition of the role of preventive measures and proactive healthcare management in reducing fall incidence [42]. However, the substantial proportion of participants who strongly agree with the statement that falling is a normal consequence of aging highlights the persistence of misconceptions and beliefs that may hinder efforts to promote fall prevention behaviors [43]. Addressing these perceptions through targeted education and communication strategies is crucial to fostering a more nuanced understanding of falls and empowering older adults to take proactive steps towards fall prevention [44]. Overall, these findings highlight the importance of tackling both knowledge and perception barriers in comprehensive fall prevention initiatives, with a focus on promoting positive attitudes and beliefs that encourage active engagement in preventive behaviors among older adults.

The current study adds further evidence that fear of falling is common among robust community-dwelling older people. In fact, it is consistent with previous studies involving community-dwelling older adults that's fear of falling (FOF) is prevalent among community-dwelling older adults, especially women, varying between 21–85% regardless of their fall history, health status, or mobility [45–48]. On the other hand, the use of FES-I, an activity-related multidimensional questionnaire, was found to be more sensitive and relatively objective in detecting FOF when compared to self-reported, single-direct question about FOF. This may partly explain why a relatively high prevalence of FOF

was identified in the current study, especially among participants with no history of falls [49, 50]. Also, it could be related to a lack of fall prevention and education programs. We still face the challenge of scaling up and implementing such programs in Saudi Arabia. Little is known about fall prevention and education programs in Saudi Arabia, and the extent to which this is enforced in older adults' health routine care is also unknown.

The current study argues it is necessary to initiate changes in practice, organizational supports, and system functions to implement evidence-based fall prevention interventions. An improved awareness of fall risk among older adults could translate to greater uptake of fall prevention activities, with potential downstream impacts on quality of life, fall frequency, fear of falling and healthcare costs.

Potential limitations of the present study should be acknowledged when interpreting the findings. Firstly, there is a potential limitation related to sample selection bias, as participants were recruited from district community center where it can be presumed that they self-selected to participate. They may only represent a sample of a group of community-dwelling older women who are relatively active, which could limit the generalizability of the findings to other vulnerable populations. Therefore, future studies should aim to include a larger and more diverse sample of older adults with varying levels of health, mobility, and living environments. Furthermore, the assessment of knowledge and fall perception among older adults was based on interview administration, which may be subject to recall bias and social desirability bias. Despite this limitation, we believe this research is an important first step in understanding the knowledge and perception of falls among older adults. Additionally, the high prevalence of falls observed in this study is an important finding that warrants further investigation into the underlying risk factors contributing to this prevalence among community-dwelling older women in Saudi Arabia. Understanding these risk factors is crucial for designing targeted interventions aimed at reducing fall incidence, enhancing quality of life and reducing healthcare costs. Lastly, the cross-sectional design of this study prevented us from determining the causal relationship between FOF and the identified risk factors. Future studies should focus on longitudinal studies to explore the causal relationship between FOF and other established risk factors in cross-sectional studies. Future studies should also aim to evaluate the feasibility and sustainability of implementation strategies for fall prevention interventions within the healthcare systems of Saudi Arabia.

## Conclusion

The findings of this study emphasize the need for multidimensional strategies to address falls and FOF among community-dwelling older women in Saudi Arabia. By leveraging existing knowledge and perceptions towards fall prevention and implementing evidence-based interventions, healthcare professionals can work towards reducing the burden of falls and enhancing the overall health outcomes of older adults in Saudi Arabia.

## Abbreviations

|        |   |
|--------|---|
| ADL    | Activities of daily living                      |
| BMI    | Body mass index                                 |
| FOF    | Fear of falling                                 |
| FES-I  | Falls Efficacy Scale-International              |
| STEADI | Stopping Elderly Accidents, Deaths and Injuries |
| TUG    | Timed Up and Go                                 |

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## Authors' contributions

M.A. was involved in the conception of the study, data collection, performed the analyses, drafted the manuscript, and revised the manuscript.

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No funds were received.

## Availability of data and materials

The data that support the findings of this study are available upon request to the correspondent author.

## Declarations

### Ethics approval and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the Declaration of Helsinki and its later amendments or comparable ethical standards. This study was approved by the College of Medicine Institutional Review Board at King Saud University, Riyadh, Saudi Arabia (E-19–3728), and all participants provided informed consent prior to participation. If participants were not deemed capable of providing consent for themselves for participation in the study (e.g. not educated), informed consent has been obtained from their guardian.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

### Author details

<sup>1</sup>Department of Health Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, 11433 Riyadh, Saudi Arabia.

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