Review Article

Metabolic syndrome is associated with an increased risk of falls in the elderly

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ABSTRACT

Numerous studies have investigated the causes of falls in the elderly. However, there is little information about metabolic syndrome (MS) as a risk factor for falls in older adults. No evaluations have given a qualitative overview of studies examining the relationship between MS and falls in the elderly. We did a literature search in electronic databases to look for studies that assessed a link between MS and falls among people over the age of 55 years. We found three studies of high quality. These included 2774 people with an average age of 72 years. Even after controlling for other risk factors, two studies found that MS was significantly associated with an older adult's 1.3–2.5-fold increased risk of falling. We found that MS and its independent components were strongly linked with falls among the elderly, even after correcting for numerous variables.

Natl Med J India 2023;36:370–3

INTRODUCTION

Metabolic syndrome (MS) comprises five medical conditions: abdominal obesity, hypertension, hyperglycaemia, high serum triglycerides and low serum high-density lipoprotein.[1] Based on these five medical conditions, MS has been defined differently by various organizations[2] such as the WHO,[3] United States National Cholesterol Education Program Adult Treatment Panel III,[4] the American Heart Association, the National Heart, Lung, and Blood Institute,[5] and the International Diabetes Federation[6] in 1999, 2001, 2004 and 2006, respectively. However, a joint interim statement of these organizations published a guideline to harmonize the definition of MS in 2009.[7] Among all non-communicable diseases, MS has been a major public health problem especially among the older population causing cardiovascular disease, type 2 diabetes and all-cause mortality.[8,9]

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[**To cite:** Alzahrani MS, Vennu V. Metabolic syndrome is associated with an increased risk of falls in the elderly. *Natl Med J India* 2023;**36:** 370–3. DOI: 10.25259/NMJI_944_2021]

Globally, the population aged ≥65 years increased from 6% in 1990 to 9% in 2019. In 2019, there were 703 million persons aged ≥65 years worldwide.[10] The number is projected to double to 1.5 billion in 2050.[10] About 20%–25% of the world's older population has MS.[11] About 34% of older people in the USA have MS.[12] The proportion is increasing with age, particularly among racial and ethnic minorities.[13]

In this elderly population, falls and their consequences are major concerns for families, caregivers and healthcare providers due to their morbidity, mortality and expense associated with treatment.[14–16] Although many studies have attempted to define the risk factors for falls in older adults, a previous review provided an updated summary of the risk factors for falls in the ageing population.[17] However, we found little literature on the association of MS with falls in the elderly.[18–20] No review has provided a qualitative description of studies examining the association between MS and falls in the elderly.[17] We aim to address this gap in knowledge by the following hypothesis: MS would be associated with falls among the elderly.

METHODS

We did a literature search in various electronic databases (such as PubMed, CINAHL Plus, Web of Science, and EMBASE) using the following search strategy: ('elderly' OR 'older') AND ('metabolic syndrome') AND ('fall' OR 'falls') until June 2021. We included studies conducted on humans with full text written in English. We excluded studies that did not specifically examine an association between MS and falls among persons aged ≥55 years. All disagreements between the authors were resolved consensus. The literature search was cross-referenced with references in the included studies. We used the National Institute of Health Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies to assess the risk of bias in the included studies.

RESULTS

The search in electronic databases yielded three studies[18–20] that examined the association between MS and falls in older adults. These studies quality was good (Table I). However, one study did not examine the association between MS components and falls.[19] The authors did not mention the outcome assessors' blindness to participants' exposure status in any of the included studies. None of these studies could also pinpoint a participation rate of at least 50% of eligible participants. In addition, overtime assessment and rate of loss to follow-up do not apply to these included studies due to the cross-sectional design.

Table II shows the characteristics and summary of outcomes of the included studies. All three included studies were designed as cross-sectional with a total of 2774 participants. The average age of the patients was 72 years. Most were women with Malay, Chinese, Indian, Italian and Taiwanese ethnic backgrounds. All the patients had various comorbid conditions.

All three studies that assessed and defined MS (exposure) and fall (outcome) were almost similar. Findings from two included studies[18,20] showed evidence that MS was significantly associated with a range of 1.3–12.50 higher risk of falls among the elderly even after adjusting risk factors such as age (odds ratio [OR] 1.32), gender (OR 1.32), comorbid conditions (OR 1.33), weakness (OR 1.31), weight loss (OR 1.37) and exhaustion (OR 1.33). These two studies also revealed that each MS component was significantly associated with falls in this population. One study[19] found that MS was independently associated negatively with a reduced probability of falling over one year among the elderly with Parkinson disease who fell (Table III).

DISCUSSION

Our review provides a qualitative description of studies examining the association between MS and falls in the elderly. The evidence shows that a cluster of MS and its independent components were significantly associated with falls among the elderly. A significant association was found even after adjusting for risk factors such as age, gender, comorbid conditions, weakness, weight loss and exhaustion. Our study is probably the first to show the relationship between MS and falls in this population.

In this review, we found only three studies that investigated the relationship between MS and fall in older adults in Malaysia,[18] Italy[19] and Taiwan[20] after a search in various electronic databases. A strong relationship between MS and falls among the elderly has been reported in these studies. A recent study from Malaysia found that MS was a significant independent risk factor for falls, with an odds ratio (OR) of 1.31 (95% confidence interval [CI] 1.02–1.68) among urban dwellers ≥55 years of age.[18] The study has also shown that weakness, unintentional weight loss, self-reported exhaustion, and slow walking speed were mediating factors for the association between MS and falls in this population. However, the Malaysian study could not explain a possible reason for weakness, unintentional weight loss and self-reported exhaustion in the association of MS and falls. An earlier study found that low serum high-density lipoprotein was a reason for slow walking speed in this population, even after adjustment of multiple covariates.[21] All these findings correspond to previous studies that showed persons with MS had slower walking speeds and it to be a risk factor for fall.[22,23]

A Taiwanese study found that MS was a significant independent risk factor for falls in community-dwelling older adults even after adjusting for age, female gender, the Karnofsky Performance Scale, and the five-item Brief Symptom Rating Scale (OR 2.56, 95% CI 1.86–3.51).[20] The study also showed that components of MS had a statistically significant association with falls in this population. Moreover, in this study, participants who fell were more likely to have abdominal obesity, hypertriglyceridaemia, hypertension and impaired glucose

TABLE I. Quality assessment of included studies

Criteria	Teoh *et al.*[18]	Laudisio *et al.*[19]	Liao *et al.*[20]
1. Was the research question or objective in this paper clearly stated?	Y	Y	Y
2. Was the study population clearly specified and defined?	Y	Y	Y
3. Was the participation rate of eligible persons at least 50%?	CD	CD	CD
4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were predetermined criteria for inclusion and exclusion in the study implemented consistently for every participant?	Y	Y	Y
5. Was a sample size justification, power description, or variance and effect estimates provided?	N	N	N
6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	Y	Y	Y
7. Was the time-frame sufficient to reasonably expect to see an association between exposure and outcome if it existed?	Y	Y	Y
8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g. categories of exposure or exposure measured as continuous variable)?	Y	N	Y
9. Were the exposure measures (independent variables) clearly defined, valid, reliable and implemented consistently across all study participants?	Y	Y	Y
10. Was the exposure(s) assessed more than once over time?	NA	NA	NA
11. Were the outcome measures (dependent variables) clearly defined, valid, reliable and implemented consistently across all study participants?	Y	Y	Y
12. Were the outcome assessors blinded to the exposure status of participants?	NR	NR	NR
13. Was loss to follow-up after baseline 20% or less?	NA	NA	NA
14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	Y	Y	Y

CD cannot determine NA not applicable NR not reported Y Yes N No

TABLE II. Characteristics of the included cross-sectional studies

Authors	Year	Country	*n*	Mean age (years)	Women (%)	Ethnic group	Comorbid conditions
Teoh *et al.*[18]	2020	Malaysia	1415	68.5	57.2	Malay, Chinese and Indian	Heart attack, chronic kidney disease, stroke, asthma, arthritis and Parkinsonism
Laudisio *et al.*[19]	2016	Italy	194	73.0	36.5	Italians	Parkinson disease
Liao *et al.*[20]	2012	Taiwan	1165	74.9	54.3	Taiwanese	Hypertension and diabetes

TABLE III. Summary of outcomes of included studies

Authors	Criteria used to define MS	Measure of fall	The definition used for fall	Outcome
Teoh *et al*.[18]	The modified Adult Treatment Panel III criteria for Asians	Self-reported question: Have you fallen in the past 12 months? with answers: No and Yes	Unintentionally coming to rest on the ground, floor, or lower level.	MS and each MS component was statistically significantly associated with falls in urban dwellers aged ≥55 years, with 31% increased odds of falls.
Laudisio *et al*.[19]	The National Cholesterol Education Program's ATP-III criteria	Self-reported question: Have you experienced any falls during the previous 12 months, and if so, how many falls occurred?	A sudden loss of balance causes contact of any part of the body with the floor.	MS was independently associated with a reduced probability of falling over one year among older patients with Parkinson disease.
Liao *et al*.[20]	The modified Adult Treatment Panel III criteria for Asians	Self-reported history of falls was asked retrospectively.	An event in which a person comes to rest unintentionally on the ground or at another lower level, not due to any intentional movement, a major intrinsic event (e.g. stroke), or extrinsic force (e.g. forcefully pushed down or knocked down by a car).	MS was significantly associated with a 2.5-fold higher risk of falls in community-dwelling older adults.

MS metabolic syndrome

tolerance. Hypertension and diabetes have received more attention from clinical investigators as explanatory predictors for falls among the components of MS in older adults. Also, previous studies showed that the risk of falling increased significantly in older adults with uncontrolled hypertension,[24] diabetes[25,26] and obesity.[27,28] However, the actual relationship between hypertension and hypertriglyceridaemia and the risk of falls is unclear among older adults.[29,30] A possible explanation for this might be that the indirect association of falls with obesity, hypertension, sedentary lifestyle and low serum high-density lipoprotein is associated with elevated triglycerides.[30,31]

However, the outcomes of the above-mentioned studies contradict the study by Laudisio *et al*.[19] This Italian study found that MS was independently associated with a reduced probability of falling over 1 year among the elderly with Parkinson disease. In other words, MS was associated with a reduced number of falls among older adults with Parkinson disease who fell. These findings appear to be due to a common pathophysiological pathway of the peroxisome proliferator-activated receptor in MS, which may reduce the incidence of falls in these patients by protecting both the skeletal muscle and the central nervous system.[32]

This review shows evidence of an association of well-defined MS with falls among the elderly from two studies[18,20] that had a larger sample size. The limitations of this review are as follows. First, all three studies included in this review were cross-sectional and used self-reported falls as the outcome. This study design cannot determine a causal association or cause–effect relationships between MS and falls in this community. Self-report of falls might be subject to recall bias. Therefore, it may result in an underestimation of the actual occurrence of falls. The second included studies, mainly two studies,[18,20] that enrolled community-dwelling older adults, and the results cannot be appropriately applicable and generalized to other elderly populations across various settings. Finally, this narrative review lacks the rigorous search methodology, quality assessment and independent duplicate data abstraction of a systematic review. However, a systematic review was not feasible due to the small number of studies examining MS as a predictor of fall outcomes.

One of the issues that emerge from these findings is MS is also a risk factor for falls among the elderly, along with intrinsic and extrinsic risk factors that were reported in the previous review.[17] The evidence from this review might help clinicians assess MS as a risk factor for falls in community-dwelling older adults. This finding has important implications for developing strategies to reduce the risk of falls in this community by including MS among multifactorial assessments. Although falls among the elderly are common due to ageing, they have been associated with many risk factors. Some of these cannot be altered such as age and gender. However, many other risk factors in the earlier review[17] are preventable in this community, including MS and its components.[33–36] Appropriate assessment of MS and its components and other risk factors for falls can help identify elders with an increased risk of falls. As a result, it reduces the negative impact of falls and associated costs in this population.

More than 63% of urban participants aged 65–74 years in the Indian setting had MS, which affected about one in two older persons, with urban instances being substantially more than rural.[37] In view of the most recent statistics for MS in India, a call to action for urgent public health measures is needed to ensure screening and early diagnosis of MS and its components. This can prevent many medical events, including the risk of falling, by starting the right interventions, including lifestyle changes, especially in India's ageing population. Increased physical activity (at least 30 minutes of daily walking)[33] and a healthy, calorie-reduced diet[34] are important initiatives to implement.

Numerous studies back up the importance of leading a healthy lifestyle. The International Obesity Taskforce claims that population-level sociopolitical changes are required to reduce the incidence of MS.[38] Another study found that consuming an imperial pint of milk or other dairy products daily could reduce the chance of having MS.[35] People who followed a paleolithic eating pattern and had at least one of five measurable components of MS had improvements in three of the five components over time, according to a comprehensive evaluation of four randomized controlled trials.[36]

CONCLUSION

Our main goal was to provide a qualitative overview of research that explicitly looked at the connection between MS and falls in older adults. Even after correction of numerous variables, the results suggest that a cluster of MS and its independent components were strongly linked with falls among the elderly.

ACKNOWLEDGEMENTS

We thank the College of Applied Medical Sciences Research Center and the Dean of Scientific Research at King Saud University for their support.

Conflicts of interest. None declared

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