

Mini Review Article

Obesity and its relationship with falls, fracture site and bone mineral density in postmenopausal women

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Abstract

Obesity in elder women is a difficult problem for public health, as it is related to increased incidence of fall-related injuries and fractures. The kind of fall-related fracture seems to relate to the distribution of body mass. A review of the literature was carried out based on systematic searches of electronic databases (PubMed/Medline). The results of this mini-review did not support that obesity increases the risk of falls during post-menopause compared to normal weight women. However, there was a relation between obesity and site of fractures.

Keywords: Obesity, Elderly, BMI, Postmenopausal woman, Fractures

Introduction

Obesity constitutes a disease that unfortunately presents a continuously increased tendency in the last decades. In the USA, for the period of 2007-2008, the tendency was nearly 35% for the elderly women¹. Obesity is a serious problem for the health and functionality of old people, as there is some evidence that supports an increased risk for falling and fall related injury. Obese elderly women have a relatively higher risk for falling, in relation to women with a healthy weight². This greater risk of falling is responsible for a number of fractures and fall-related injuries. On the other hand, there is an opinion that fat mass could be a protective factor during landing on the ground.

Method

A review of all current literature on the topic was carried out based on systematic searches of electronic databases (PubMed/Medline) using the key words of obesity, elderly, body mass index (BMI), postmenopausal woman, fractures. Only studies published after 2000 and in the English language were considered for inclusion. We identified 750 references in our literature search, were 10 excluded because of duplication and 43 considered to be potentially eligible (Figure 1). After the full-text screening, 17 studies met our inclusion criteria.

Differences of sex

The results of literature searching showed that elder women present a higher incidence of fall-related injuries

when compared with elderly men³⁻⁶. This difference is not well understood, but it's related to the fact that women are frailer and have a longer expectation of life, and thus they present higher incidence of falls⁵. Besides this, elder men appear to have higher mortality rates because of fall incidence, and so, women's fall-related injury seems higher than men's⁷.

Previous studies support that the female gender was a risk factor of falling in elder people. The other factors were the older age and the poor visual acuity that present in elderly women⁸.

Obesity and falling incident

The old people suffer from a lot of diseases that contribute to the increased incidence of falling. The most important risk factors are the coexisting diseases, as Parkinson and cardiovascular disease, which could cause a loss of balance and walking difficulty. These factors increase the need for medical support and drug use, especially with the coexistence of obesity. Moreover, obesity is responsible for the appearance and deterioration of diseases like type-

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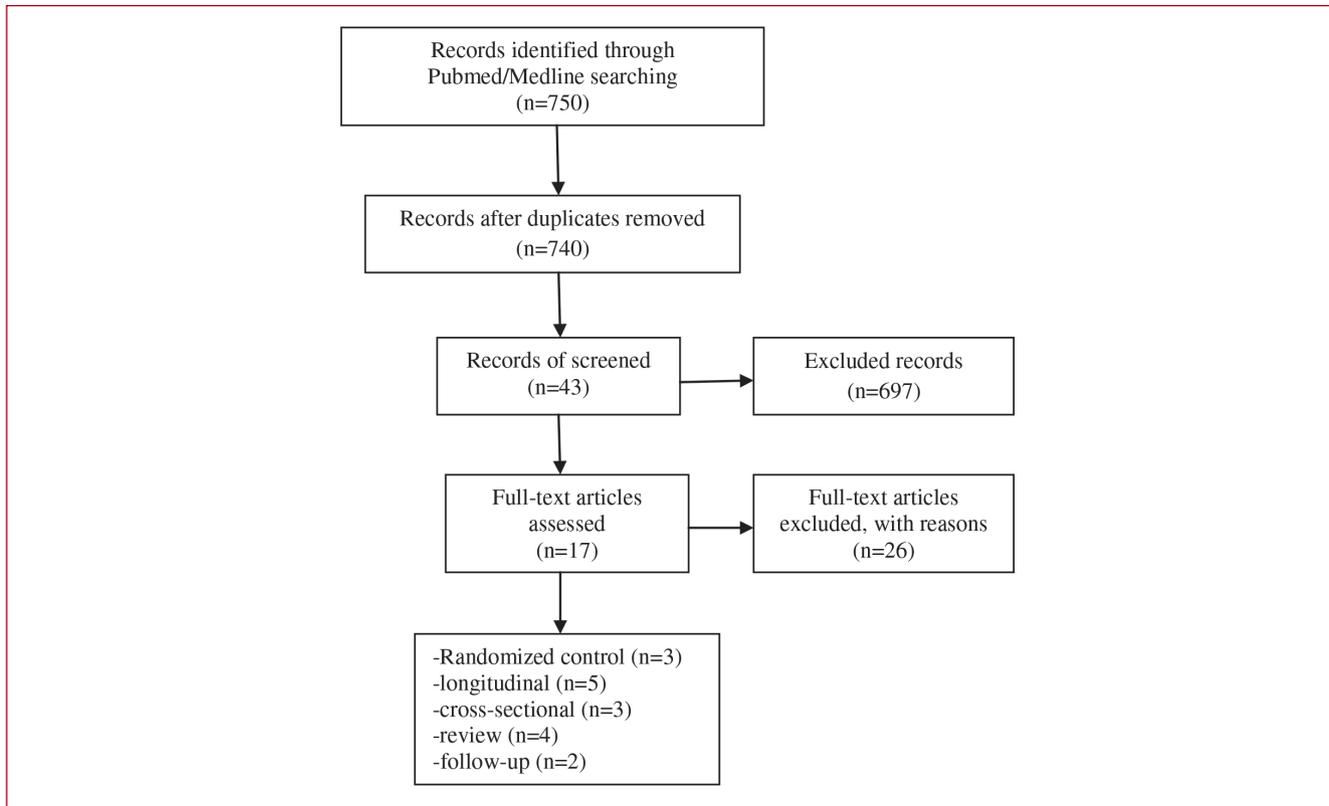


Figure 1. Flow diagram depicting the selection process of studies investigating the risk of fall in obese elderly women.

2 diabetes and peripheral neuropathies, which leads to increased incidence of falling. Approximately 30-40% of older adults will fall annually, but the exact influence of obesity on fall incidence still remains contributed⁹.

Another study found that a novel associated factor that increased the incidence of fall in elder women, were the visual acuity and waist-to-hip ratio. In obesity, the circumference of waist reveals the existence of central obesity and has a major independent role as a fall-related indicator⁸. The existence of central obesity predisposes the development of metabolic syndrome, and at the same time affects the stability of body center and the incidence of fall-related injuries¹⁰. The measure of waist circumference is often used during a geriatric health examination for assessing the visceral fat¹¹, as it was found an association with the frailty in elder people¹².

In a review, it was found that there was no important difference of a fall incidence between an obese and a normal weight elderly woman¹³. Thus, perhaps the increased reported injuries of obese elderly women, is a result of the falling injuries itself. They also observed that there was only a small difference on the falling tendency for obese elderly women, but the reported injuries were mainly of soft tissues and less of bone fractures. These findings were also confirmed from other researchers¹⁴.

The results from a laboratory experiment for falling revealed two possible mechanisms, responsible for the neuromuscular reaction of obese elder women during falling. They are called as *lower* and *elevating mechanisms*, and they explain the differences of the body correspond during a fall incidence^{15,16}. It is speculated that the coexistence of obesity in elder women, decreases the ability of joints to react on time to support the body mass during falling. The researchers observed an average of 160-millisecond delay of corresponding for an obese body to react to a fall¹⁶⁻¹⁸.

The increase of fall accidents among obese elderly women is a major health problem in high-income countries¹⁹, as it is related to high socioeconomic status, and so the incidence of fall-related injuries appears to be more common²⁰. In countries with insufficient intake of food and water, the numbers of obese people are too low in relation with the ones of developed countries²¹. As a result, the associated injuries of fall accidents in elder people are higher in developing countries.

Obesity and site of fracture

In most of the cases, obesity is associated with an incidence of fall-related fractures in elderly women. Obesity is responsible for a high incidence of fall mainly because

an obese subject is less well able to protect itself against a fall²²⁻²⁴. There are several studies that support that the site of fracture is depended on BMI (body mass index)²⁵⁻³⁰. In Global Longitudinal Study of Osteoporosis in Women (GLOW) was found that obesity, in contrast to widespread belief, is not protective against fracture, but also responsible for certain fractures, mainly in the ankle and upper leg. The study revealed a higher incidence of those two and a lower incidence of wrist fractures in contrast to non obese women. The possible explanation is that in obese people, abdominal fat tissue has a protective role for hip and pelvis, but ankle and legs have less fat, predisposing them to more fractures due to falling²⁵. Overweight or obese individuals are possible to have a backward or sideward fall, and thus the wrist is less exposed in contrast to normal weight ones³¹. In another study, obesity was associated with a protective effect of abdominal fat tissue on hip, but without a relation on either wrist or ankle fracture²⁶.

There is a study for obese women that report a higher incidence of ankle fractures, but a reduced hip fracture, as the extra fat mass in pelvis and femur protects this area during a fall³². The higher incidence of exaggeration of introversion and extroversion of the ankle and lower leg in obese individuals could be the reason for the increased prevalence of fractures at these body parts. Also, the increased body mass is responsible for the increased pressure (stress) on some sites, predisposing to fracture³³. Apart of hip fractures, there are types of injury and several other anatomical sites that are sensitive to a fall accident. The most frequent injury among obese older women is the sprains/strains³⁴. These kinds of injuries are responsible for muscle pain and affected flexibility, with a high cost of treatment, and the probability of loss of the independent living³⁵⁻³⁷.

Bone mass and obesity in elder women

There is some evidence that the additional fat mass of the obese elderly women has a protective role during a fall. The explain of this mechanism lands on the increased density of bone mass, that has a protective role against fractures, and the extra fat mass that creates a protective cushion during the landing on the ground. There is increasing evidence in recent studies that, the beneficial effects of fat mass on bone mass are various and depended on its distribution. Visceral fat has an adverse effect on bone mass, in contrast with subcutaneous fat that seems to have beneficial effects^{38,39}. There is an association between fractures, bone mass and high BMI. Obese postmenopausal women appear to have higher serum levels of estrogens comparing to normal weight^{40,41}. Estrogens are in part responsible for the higher bone mass found in women with high BMI. Apart from estrogens, there is an interaction between the adipose tissue and bone cell⁴².

Adipocytes produce adiponectin, a molecule that is inversely related to BMI but seems to work as a marker of a disrupted adaptive response in overweight individuals⁴³⁻⁵¹. A study found higher serum levels of adiponectin in obese

women with fractures when compared with obese women without fractures⁵². Another factor that interferes with bone metabolism is leptin that acts in two contradicted mechanisms^{52,53}. High serum levels of leptin are associated with increased bone mineral density. On the other hand, when leptin acts via central nervous system, it is responsible for decreased bone formation⁵². Another adipose tissue product is inflammatory cytokines that could affect the balance between bone absorption and formation⁴³⁻⁵¹.

Predicting the risk of fall

As the majority of fall incidences in the elder individuals are characterized as locomotive falls (80-90%)⁵³, there is an essential need for a good assessment to detect them. There is no agreement between researchers for which tests are more appropriate in a specific situation⁵⁴. Most tools rely on assessments of balance and strength⁵⁵⁻⁶⁰, so there are not applicable in the primary care settings.

A systematic review of the literature about fall prediction tools in rehabilitation hospitals showed that the most appropriate and applicable in elderly inpatients where the STRATIFY, PJC-FRAT, and the DOWNTON Fall Risk Index. The authors concluded that, even though they had good sensitivity and specificity, the implementation of them in clinical practice is expensive both in time and practice, and they could not yet replace the empirical judgment⁶¹.

One of the tests used for assessment mobility and fall risk is the Timed Up and Go Test (TUG), which in accordance to some studies, has a limited predictive ability for community-dwelling elderly^{47,62-63}, but has better predictions in less healthy and lower functioning older people⁶⁴. TUG with a Dual Task (TUG-DT) is a better predictor for measuring mobility among community-dwelling elderly, but it has a poor prognostic validity for the quality assessment^{62,64-66}. Two others assessment tools are TUG man (Timed Up and Go Test with a manual dual task), and TUG cog (Timed Up and Go Test with a cognitive dual task), where the last one has a better predictive assessment of elderly community-dwelling persons⁶².

Conclusion

As long as the societies continue to face aging, the prevention of fall incidence of elder people is a serious problem in public health. More than 30% of people over 65 years old face a fall per year, which leads them to injury, increased mortality and loss of functioning⁶⁷⁻⁷⁰. Moreover, in the last decades, there is also an increased rate of obesity in elder people, especially in female sex. It is urgent for early interventions in order to apply a convenient and systematic assessment of fall risk factors, exercise programs, and environmental adaptation, to decrease the rates of fall incidences and injuries. In conclusion, the prevention of fall-related injury in obese elder women needs a multifaceted approach to public health, by heightened awareness for the assessment, education, referrals, and recommendation.

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