RELATIONSHIP BETWEEN TBS SCORE, BONE DENSITY AND FRACTURES IN OLDER MEN: INTEGRATIVE REVIEW

RELAÇÃO ENTRE O ESCORE TBS, DENSIDADE ÓSSEA E FRATURAS EM HOMENS IDOSOS: REVISÃO INTEGRATIVA

ALEXANDRE COUTINHO BORBA[1] ⓘD, *NEWTON LUIZ TERRA[1]* ⓘD, *SILVIA VIRGINIA COUTINHO AREOSA[2]* ⓘD

1. Pontifícia Universidade Católica do Rio Grande do Sul, Instituto de Geriatria e Gerontologia, Porto Alegre, RS, Brasil.
2. Universidade de Santa Cruz do Sul, Santa Cruz do Sul, RS, Brasil.

ABSTRACT

Population ageing is an inexorable truth. This is the reason for an increase in the number of studies analyzing common pathologies, such as osteoporosis, in older people. Osteoporosis is a disease resulting from bone fragility, thus increasing the risk of fracture. Although the occurrence is predominant in women, studies analyzing the male population have raised interest among the scientific community. Nevertheless, there is no consensus regarding the best way to estimate the risk of fracture. Bone density testing and TBS (trabecular bone score) assessments are alternatives available for diagnosing. To assess the relationship between bone mineral density, the changes in TBS and fractures in older men. We conducted an integrative review of the literature in the LILACS, Scopus and PubMed databases, searching for studies in the last five years. We found 97 studies, and five of these matched our guiding question. We found five articles that matched our selecting criteria. All five presented the importance of using TBS for a better accuracy in improving the estimate of risk of fracture in older men. The association of TBS with bone density is important to best estimate the risk of fracture in elder men. ***Level of Evidence II, Diagnostic Studies.***

Keywords: Bone Density. Osteoporotic Fractures. Men's Health. Aged.

RESUMO

*O envelhecimento populacional é uma realidade inexorável. Portanto o número de estudos relacionados às patologias comuns em idosos, como a osteoporose, tende a crescer. A osteoporose é uma doença caracterizada pelo aumento da fragilidade óssea, elevando o risco de fratura. Embora seja uma patologia predominante em mulheres, os estudos analisando a população masculina tem despertado interesse na comunidade científica. Entretanto, ainda não há consenso sobre a melhor forma estimar o risco de fratura. A densitometria óssea e a avaliação do trabecular bone score (TBS) são alternativas disponíveis para o diagnóstico. Avaliar a relação entre a densidade mineral óssea, a alteração do TBS e a presença de fratura em idosos masculinos. Realizou-se uma revisão integrativa da literatura nas bases de dados LILACS, Scopus e PubMed, procurando estudos realizados nos últimos cinco anos. Foram encontrados 97 estudos, sendo que cinco se adequavam aos nossos critérios de seleção. Todos os estudos mostraram a importância do uso do TBS para uma melhor acurácia no intuito de aprimorar a estimativa do risco de fratura em homens idosos. A associação do TBS com a densidade óssea é útil para estimar de forma mais adequada o risco de fratura. **Nível de Evidência II, Estudos Diagnósticos.***

Descritores: *Densidade Óssea. Fraturas por Osteoporose. Saúde do Homem. Idoso.*

INTRODUCTION

The growth of the older population is a reality. The population over 60 is the fastest growing proportionally, according to the World Health Organization (WHO). In Brazil, from 2000 to 2010, there was an increase in the number of older adults from 14.4 million to 20.6 million.[1] Rio Grande do Sul, according to the Brazilian Institute of Geography and Statistics (IBGE), is the first Brazilian state with a proportional number of older adults. Due to this phenomenon, the pathologies associated with the aging process have aroused the curiosity of researchers.

Aging is a biological, dynamic, progressive, irreversible and inevitable phenomenon that affects all living beings. During this process, morphological, physiological, biochemical and psychological changes occur, as well as a progressive loss of the individual's ability to adapt to the environment, which ultimately lead to death.[2] Therefore, the musculoskeletal system is also affected by this process, culminating in the progressive loss of bone mass due to

the imbalance between the reabsorption mechanism and the bone formation. Osteocytes, which are responsible for the metabolism of the extracellular matrix, decrease with aging, unbalancing calcium metabolism and reducing the formation of this matrix. In turn, the osteoclasts, which are responsible for resorption of bone tissue, have their activity increased, inducing the process of osteoporosis.[3,4]

Osteoporosis is a disease that is characterized by low bone mass and loss of bone tissue microarchitecture, significantly increasing the risk of fracture. It is a chronic and progressive disease, with a decrease in bone mineral density.[5,6] In practice, according to the definition of the World Health Organization, it is a disease that predisposes a fragility fracture, that is, one that occurs in a situation that would be insufficient to fracture a normal bone.[7] This disease does not present characteristic signs and symptoms; this is a factor that delays early diagnosis and consequent prevention of fractures. Although osteoporosis is prevalent in women, the number of studies focused on the male population has increased, due to the data already described on population aging.

In the last 20 years male osteoporosis has been recognized as a public health problem. It is estimated that about 30% of hip fractures occur in men. The probability of a fragility fracture in men after the age of 50 is 13%.[8] Some risk factors are determinants for this pathology in men. In a recent study, the prevalence and associated risk factors for osteoporosis were analyzed in 325 men aged 50 or over. During the evaluation of this group, it was found that 44.6% of the participants had osteopenia and 15.4% of the study participants had osteoporosis. The most prevalent risk factors were low body mass index (BMI), sedentary lifestyle in the last 12 months, advanced age, smoking, white ethnicity, and history of maternal fracture over the age of 50.[9]

The diagnosis of osteoporosis is made through the clinical history of fractures that is characteristic of bone fragility and/or by bone densitometry (DXA). Densitometry is an accurate, non-invasive, low-dose radiation test that is accessible to most people. The densitometry apparatus uses X-rays of two distinct energies to provide quantitative and qualitative information related to bone mineral density. Currently, a complement to traditional bone densitometry is available which is the *Trabecular Bone Score* (TBS). TBS is a calculation algorithm based on DXA images that improves fracture prediction.[10] It is a simple and fast method performed by installing software on the usual densitometry devices that evaluates the quality of bone microarchitecture.[11] The use of this tool has been authorized in Europe since 2009, in the United States since 2011. In Brazil, it was released by the National Health Surveillance agency (Anvisa) in 2015. However, we noticed in medical practice that not all clinics that work with bone densitometry have adopted the application of TBS in their routine.

Therefore, the current challenge for those who treat osteoporosis is to optimize the identification of patients at risk of bone fracture, although there is no consensus on how to best achieve this goal. Therefore, this integrative literature review aims to present the relationship between TBS score, bone density and fracture in the male older population.

METHODS

This study is an integrative literature review with data collection performed from secondary sources, through a bibliographic survey and based on the following guiding question: What is the relationship between bone mineral density, TBS score and the presence of fractures in the male older population. To survey the articles in the literature, a search was carried out in the following databases: Latin American and Caribbean Literature in Health Sciences (LILACS) and *Medical Literature Analysis and Retrieval System online* (MEDLINE) and Scopus. The research was carried out on September 25 and 26, 2019 and the following descriptors and their combinations in Portuguese and English were used with the help of Boolean operators (*AND* and *OR*); parentheses for ordering operators and quotation marks for identifying compound words, as follows: ("densidade mineral óssea" *OR* osteoporose) *AND* ("*bone mineral density*" *OR* osteoporosis), *AND* ("escore do osso trabecular"/"*trabecular bone score*"), *AND* ("fratura em idosos homens"/"*fractures in older male*"). In addition, we searched for data from the CAPES database of theses and dissertations, as well as original articles linked to the literature found in the aforementioned search.

The inclusion criteria defined for the selection of articles were: original articles published in Portuguese and English; articles available in full that portrayed the theme related to the review carried out, and articles published and indexed in these databases in the last five years. Articles that did not meet the established inclusion criteria were excluded from this review. To avoid excessive inclusion of articles, keywords were restricted to search fields *Title*, *Abstract* and *Keywords*; they must be present in at least one of the specified search fields. Additional filters were applied, such as Article language (Portuguese/English/Spanish), species (humans), sex (male), age group (older adults).

The analyses and selection of the articles were carried out by two researchers (independently), who selected the potentially relevant studies based on the titles and abstracts. When they did not provide sufficient information for inclusion or exclusion from the study, the full text was analyzed. In situations, in which there was a conflict of opinion about the inclusion or not of the study, a third researcher was called to make the tie-breaker.

The results and data collected will be presented in a synoptic table evaluating database, authors, objective, methods and results.[12]

RESULTS

The search performed in the aforementioned databases found a total of 97 articles related to the theme of the review. Among these, nine were found in the LILACS database, 32 in MEDLINE and 56 in Scopus. There were articles found in more than one base: five were found in the three bases, 11 were found in Scopus and MEDLINE, three were found in MEDLINE and LILACS and one was found in Scopus and LILACS.

After the analysis of the abstracts found, 56 were excluded, leaving only 21 original articles that partially met the inclusion criteria and were selected for detailed analysis in full by two evaluators. Among these 21 articles, one was immediately excluded as the original article was in French. Another article was excluded because it was in a population with basic pathology; in this case, it was a group of chronic kidney disease. Among the other 19 articles, there was consensus for inclusion among the researchers on three articles. On the other hand, there was a consensus of exclusion on 12 articles. Therefore, there were four other articles that generated disagreement among the researchers. As such, these four articles were taken to a third opinion that selected two of them, totaling five selected articles. Figure 1 summarizes the search.

The selected articles were organized in a synoptic table to facilitate comprehension (Table 1). In this framework, the general characteristics, Qualis, and the main results of each of the articles selected for this integrative literature review were exposed.
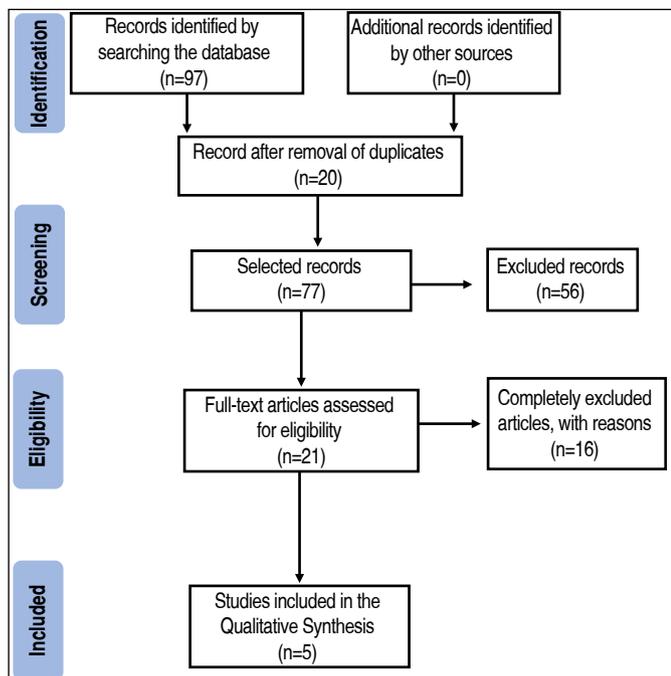
Figure 1. Process carried out in the integrative review.

Table 1. Selected articles in the LILACS, Medline and Scopus databases on integrative review.

Reference/ Qualis	Sample characterization	Objective	Main results
Iki et al.[13]/A2	N: 2012 men over the age of 65 Country: Japan	To assess the risk of fracture with the combination of FRAX and TBS in relation to FRAX alone.	In total, 22 men with MOF were identified. TBS can improve FRAX MOF prediction accuracy for Japanese older men
Schousboe et al.[14]/A1	N: 5979 men over the age of 65 -Country: USA	To assess the association between TBS and incident fractures in men independent of the prevalence of radiographic vertebral fracture.	TBS and the prevalent radiographic vertebral fracture are associated with large osteoporosis fractures incident in older men, independent of each other.
Su et al.[15]/ A2	N: 2000 men over the age of 65 Country: China	To validate and recommend practical TBS thresholds for predicting fractures in the older population	TBS in combination with BMD can predict MOF more reliably in older men than BMD alone.
Schousboe et al.[16]/B1	N: 5831 men over the age of 65 -Country: USA	To evaluate the association of TBS with clinical and radiographic vertebral fractures in older men	TBS is not associated with incidental vertebral fracture in older men when adjusted for the age and BMD of the lumbar spine; the study leaves open this association with clinical vertebral fractures. The study reinforces the influence of BMI on the calculation of TBS.
Anderson et al.[17]/B1	N: 728 Country: Australia	To investigate whether the presence of degenerative changes in the spine in older men affects TBS in the same way that they affect BMD.	This study suggests that TBS is less affected by degenerative changes in the spine than BMD. Thus, TBS may be useful in assessing the risk of fractures in men with degenerative changes in the spine.

TBS: Trabecular Bone Score; BMD: bone mineral density; DXA: bone densitometry; FRAX: fracture risk assessment tool; MOF: major osteoporosis fracture (hip, spine, wrist, shoulder).

The results of the studies included in this integrative literature review have mostly shown that there is a relationship between the decreased TBS score and the increased risk of fracture in older men. Therefore, the addition of the routine use of the TBS score assessment seems to have clinical importance in the creation of preventive measures for fractures.

DISCUSSION

Most of the selected studies reported the importance of assessing TBS *score* in clinical practice. The authors concluded that, although they still need complementary studies, the data available at the moment attest to the usefulness of this tool. Osteoporosis is characterized by the loss of bone mass as well as by the alteration of the microarchitecture which leads to bone fragility. Therefore, evaluation only by bone densitometry has been shown to be insufficient.[18] The studies found show us that isolated densitometry is not able to estimate the risk of fracture accurately.[19] This data is proven by the fact that most fractures occur in patients with bone mineral density considered normal or osteopenic.[20] Therefore, TBS appears as a useful predictor of fractures, for men, which are the focus of the current study, as well as for women.[21]

Evaluating the articles selected in this review, we note that there is a desire of the scientific community to find the best way to predict the risk of fracture and, therefore, indicate the ideal time to start treatment. We realized that each author used a way to try to improve this prediction.

Iki et al.[13] chose to analyze the use of FRAX associated with TBS to improve the accuracy of the diagnosis of osteoporosis and/or increased risk of fractures, since the isolated use of FRAX proved insufficient. The author reinforces that bone densitometry remains the gold standard for diagnosing osteoporosis, but not for assessing the exact risk of fracture, since half of hip fractures occur in patients without osteoporosis.[13] In the study, the author highlights the limitations of FRAX alone and reinforces the use of TBS, which evaluates the texture of the gray level in densitometry images, thus more accurately evaluating the bone microarchitecture. The elevated TBS score, i.e. darker shades of gray, indicates a stronger bone.[13] According to some authors, elevated TBS would have a predictive value for fractures.[22,23] The author also highlights a study conducted by Leslie et al.[24] in Canada that also showed the usefulness of the association of FRAX with TBS to estimate the risk of hip fractures. Iki et al.[13] demonstrated in his pioneering study, in the Asian continent, that patients with low TBS are at high risk for MOF; he further stressed the importance of using FRAX as an associated tool to optimize this evaluation.[13,24]

This study presents some possible confounding factors, such as the low number of fractures, perhaps because it evaluates a healthier population without major underlying pathologies.

The study by Schousboe et al.[14] gave rise to several other studies, within the same line. The results reinforced the fact that most fractures occur before the diagnosis of densitometric osteoporosis and, therefore, there is a need for new alternatives.[21] The author states that low TBS score is associated with the diagnosis of MOF in women, regardless of FRAX or DXA.[25] The objective of the research was to study the relationship of TBS with vertebral fracture without clinical repercussion, since both measures reflect changes in the microarchitecture. The patients subjected to the study were questioned every four months by the post office about the presence or not of any fracture, and performed face-to-face revisions every two years, whenever X-ray examinations of the dorsal and lumbar spine were performed in the profile. The average age of the evaluated population was approximately 73 years.[14] The author found data that associate the use of TBS modestly with MOF, considering it a useful tool, but not mandatory in the management of this pathology. In addition, he demonstrated that the associated use of the TBS score and bone

density assessment with the investigation of incidental vertebral fracture optimizes risk assessment for fractures. The author cites the reference from the Canadian study from Manitoba that associated TBS with hip fracture, but not with MOF.[14]

Su et al.[15] warn about population aging, which is a global trend. It is estimated that 45% of hip fractures will occur in Asia by 2050.[26] Thus, the author sought to study if the association of TBS evaluation with bone mineral density can optimize the follow-up of these patients. The study showed that patients with osteopenia and low TBS have a higher predictive value for fracture than isolated osteoporosis.[15]

In a study conducted in Australia, Anderson et al.[17] decided to investigate if the TBS score is affected by degenerative changes in the spine, in the same way that bone density is affected. There is consensus in the literature that older men have a tendency to increase bone mass secondary towards degenerative changes and, therefore, there is a need to seek new techniques for a better diagnostic accuracy of fracture risk.[27] In fact, there are reports that show that this fact is observed more in men than in women.[28,29] The mean age of the study population was 63 years, approximately, and the alteration that most affected the result of DXA was the presence of osteophytes. Padlina et al.[28] demonstrated similar results in a study conducted with women stating that TBS is less affected by degenerative changes than bone density to estimate fracture risk.

Although our study was based on a very narrow question, we noticed in our research an increasing number of evaluations on the topic. Therefore, there are many studies that have evaluated the importance of using the TBS score in the routine evaluation and research of patients at higher risk of osteoporosis fracture. However, some studies have evaluated populations with a specific profile, which may impair the final conclusion on the subject.

We also reviewed a study done with patients undergoing hemodialysis. Although the author recognizes the importance of other markers such as FRAX and low vitamin D level, he defined that only low bone mineral density can be considered as a predictive factor for low impact fractures.[30] Another study conducted in a population of diabetics showed that, although the bone mineral density in prediabetic and diabetic patients is higher than that found in normoglycemics, the bone quality of bone microarchitecture (TBS) showed no difference.[31] In a cohort also performed in diabetics,

the importance of TBS evaluation in this population was reinforced, especially in the evaluation of the proximal femur.[32] The importance of the TBS score was reinforced in another article that evaluated patients with ankylosing spondylitis, in which the author concluded that patients with vertebral fractures had a low TBS score, even with normal mineral density.[33] In a case control study done in a population with *Crohn's* disease, the importance of the TBS score as a better predictor for fracture risk than the assessment of bone mineral density alone was also confirmed.[34]

Following another path, but also evaluating the TBS score, some authors have researched genetic alterations related to osteoporosis and, consequently, the most effective ways to evaluate, diagnose and treat the pathology, to prevent fractures. In a 2016 article, the authors showed that approximately 45% of cases there is variation of TBS under genetic influence, in the same way that occurs with bone mineral density, alerting to the need for more studies directed to this area.[35]

CONCLUSIONS

The use of the routine TBS score, associated with the assessment of bone mineral density, seems to be a useful tool to improve the assessment of fracture risk in the older population. Our review showed that there are still few reports of the use of this tool to evaluate the fracture outcome in men during the aging process. Therefore, we decided to expand our studies at the discussion level, since our research was directed to analyze a very specific situation, as we did not consider studies in patients who had established pathology. At the time that we expanded the research on the importance of TBS, we realized that there are other reports, in populations with previously documented disease, that strengthen the use of this additional analysis to densitometry in our medical routine *screening* for osteoporosis. Despite this, studies have not yet found an ideal way to improve this assessment, so more studies must be carried out to achieve this goal.

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