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ORIGINAL

# Association between bone mineral content and dietary patterns among Brazilian adults from *Viçosa, Minas Gerais*: a population-based study

## *Associação entre conteúdo mineral ósseo e padrões alimentares em adultos de Viçosa, Minas Gerais: um estudo de base populacional*

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## A B S T R A C T

### Objective

The aim of the study was to investigate if there is an association between dietary patterns and bone mineral content among Brazilian adults.

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**Methods**

This is a cross-sectional, population-based study. Bone health was assessed using dual-energy x-ray absorptiometry. The dietary pattern was obtained using a food frequency questionnaire. An exploratory factor analysis obtained the dietary patterns. Linear regression was used for the multivariate analysis. The research was conducted with adult individuals (20-59 years old) of both sexes residing in the city of *Viçosa*, MG, Brazil (n=572).

**Results**

Two distinct dietary patterns were identified: a "meats and alcoholic drinks" pattern, composed of condiments, alcoholic drinks, dough-based foods, and savory snacks; and a "local traditional" pattern, composed of eggs, beans, trooper's beans, margarine, butter, olive oil, coffee and tea, cereals, and tubers (factor loadings ≥0.20). Having verified the associations considering the confounding factors, we identified that the bone mineral content for males was positively associated with the "local traditional" dietary pattern (***β***=0.058; 95% CI: 0.003–0.112; *p*=0.036), and for females an inverse association with the "meats and alcoholic drinks" pattern was found (***β***=-0.057; 95% CI: -0.110 -0.003; *p*=0.037).

**Conclusion**

We identified a positive association between the local traditional dietary pattern and bone health.

**Keywords**: Adult. Bone density. Dietary intake. Nutritional epidemiology.

## R E S U M O

***Objetivo***

*Investigar se há associação entre padrões alimentares e conteúdo mineral ósseo em adultos brasileiros.*

***Métodos***

*Este é um estudo transversal de base populacional. A saúde óssea de indivíduos adultos (20-59 anos) de ambos os sexos, residentes na cidade de Viçosa, MG, Brasil, (n=572) foi avaliada por meio da absorciometria de raios-X de dupla energia. O padrão alimentar foi obtido através de um questionário de frequência alimentar; a análise fatorial exploratória foi aplicada para obter os padrões alimentares e a regressão linear foi usada para a análise multivariada.*

***Resultados***

*Foram identificados dois padrões alimentares distintos: um padrão "carne e bebidas alcóolicas", composto por condimentos, bebidas alcoólicas, alimentos à base de massa e salgadinhos, e um padrão "local tradicional", composto de ovos, feijões, feijão tropeiro, margarina, manteiga, azeite, café e chá, cereais e tubérculos (cargas fatoriais ≥0,20). Verificadas as associações considerando os fatores de confusão, identificou-se que o conteúdo mineral ósseo para o sexo masculino se associou positivamente ao padrão alimentar "local tradicional" (**β**=0,058; 95% CI: 0,003–0,112; p=0,036), e para o sexo feminino foi encontrada associação inversa com o padrão "carne e bebidas alcóolicas" (**β**=-0,057; 95% CI: -0,110 -0,003; p=0,037).*

***Conclusão***

*Uma associação positiva entre o padrão alimentar "local tradicional" e a saúde óssea foi identificada.*

***Palavras-chave***: *Adulto. Densidade óssea. Ingestão alimentar. Epidemiologia nutricional.*

## I N T R O D U C T I O N

As we age, an imbalance occurs in our bone metabolism. This natural deterioration initially causes osteopenia, subsequently evolving into osteoporosis, a disease characterized by bone fragility resulting from alterations in the microarchitecture of the bone tissue. These alterations in bone health can be assessed using biophysical parameters known as bone mineral content and density [1].

According to the literature, an individual's bone mass quantity results from the interaction between socioeconomic, genetic, metabolic, and behavioral factors, reaching its peak at the start of adulthood, at around 30 years old [2,4,5], and subsequently declining after that age. In light of this, the adoption of preventive actions that can minimize the decrease in bone mass over one's lifetime is indicated, particularly strategies that involve modifiable factors such as the practice of exercise and dietary behavior [6-8]. The latter has been studied not only regarding the intake of specific nutrients, such as calcium and vitamins D and E, but also seeking to verify the effect caused by the adoption of a particular dietary pattern [9,10].

Studying nutrients in isolation can help understand the mechanisms in the diet and bone health interaction. In practice, however, it is difficult to isolate the specific effects of a particular nutritional factor, as meals contain a combination of different foods and nutrient profiles that interact [11].The dietary pattern reflects the set or group of foods consumed by a population, enabling the composition of these individuals' diet to be shown in a more comprehensive way that reflects environmental, economic, and sociocultural questions, and ensures the provision of more accessible recommendations [12].

Due to the growing use of dietary patterns to assess the dietary intake, a more holistic approach, studies indicate that diets rich in vegetables, fish, and nutrients such as calcium, phosphorus, zinc, and vitamin D, may contribute to good bone health [13,14]. Healthy dietary patterns, with higher consumption of fish, olive oil, and vegetables, versus patterns characterized by the consumption of high-energy foods, have been considered more suitable for maintaining bone health [15-17]. The majority of these studies were not performed with representative samples and discuss dietary patterns only in the region in question. In Brazil, we identified only one study, with older and post-menopausal women with diagnoses of osteopenia and osteoporosis [18]. Thus, it is necessary to study specific dietary patterns for the Brazilian population and with representative samples. Furthermore, we believe that evaluating dietary patterns is the most recommended approach for explaining the association between diet and bone health, and that studies of patterns, instead of isolated nutrients, can be more easily used in public health strategies [12,19].

By studying this relationship, we can therefore understand the potential role of dietary factors in bone health, providing data that seeks to contribute with the adoption of more suitable, sex-segmented strategies for bone disease prevention. Thus, the aim of this study was to investigate whether there is an association between the dietary patterns and the Bone Mineral Content (BMC) of Brazilian adults.

## METHODS

This is a cross-sectional, population-based study carried out by the Health and Diet Study group (ESA - *Viçosa*) in the Municipality of *Viçosa*, MG, Brazil, between 2012 and 2014. This project is part of a larger study that evaluates the health conditions of the adult population in *Viçosa*, entitled "Metabolic syndrome and associated factors: a population-based study with adults in Viçosa-MG," composed of adult individuals of both sexes (20-59 years old), who are not institutionalized and live in the city's urban area. The research methodology is described in detail in another article [20]. This study was approved by the Research Ethics Committee of the Federal University of *Viçosa*, MG (no 008/2012) and all the participants signed an informed consent form.

The sampling process was by clusters, in two stages. The units of the first stage were the census tracts and those of the second were the households. Once the census sector and the blocks were selected, in that order, the research procedures were informed to those who met the inclusion criteria. The sample size was calculated using the *OpenEpi* program, online (version 3.03a), considering the following: the reference population from the 2010 census (43,431 individuals); an expected prevalence of 50%, when the outcome prevalence in the population is unknown; a 5% sampling error; and a 1.5 design effect, with a total minimum need of 572 individuals. A 10% addition was made to this value for losses and 10% to control the confounding variables, resulting in a total estimated sample of 687 individuals.

The BMC was evaluated via dual energy X-ray absorptiometry (DXA), using the Lunar Prodigy Advance DXA System model (GE Healthcare). It was carried out by a radiology specialist, respecting the recommendations of the International Society for Clinical Densitometry [21]. The absolute values of the BMC (g) were considered for the statistical analyses.

The dietary intake was evaluated based on a quantitative-type Food Frequency Questionnaire validated for the Brazilian population [22]. The Food Frequency Questionnaire included questions related to the habitual consumption of 95 food items, allocated into 26 food groups, over the period of a year, based on consumption frequencies that varied from 0 to 12 times and previous day, week, month, and year time units. Food portions were defined as small, medium, large, and extra-large, based on the consumption of each food item in grams. The medium portion, defined as the reference, was presented in home-made measures and in grams to the research participants. To quantify the dietary intake, we used a model that transforms the different frequency categories into daily consumption and attributes a weight to each category. The sum of these values generates scores that correspond to a number of times a day the foods were consumed [23]. When identifying the dietary patterns, items like soy milk and linseed/chia were excluded, as they presented a consumption frequency below 15% [24].

The sociodemographic and behavioral variables included in the study were: age group (20-29 years old, 30-39 years old, 40-49 years old, and 50-59 years old), education (0 to 3, 4 to 7, or ≥8 years of study), menopause (yes or no), smoking (smoker, ex-smoker, non-smoker), evaluated through a semi-structured questionnaire and nutritional state. This was calculated by means of the Body Mass Index (BMI), using the weight (kg) and height (m) and classified into: eutrophic (BMI ≤24.99 kg/m$^2$) and overweight (BMI ≥25.00 kg/m$^2$) [25]. Body weight was obtained using an Ironman BC-544® model Tanita digital scale (0.1 kg precision). Height was obtained using a wall stadiometer (0.5 cm precision). Finally, for 25-hidroxivitamina D [25(OH)D], blood was collected by a qualified professional between 7 and 10 AM, with the voluntary having fasted for 12 hours, using the peripheral venipuncture technique. The 25(OH)D was evaluated by means of chemiluminescence using an Architect 25(OH)D kit, employing the Architect/Abbott equipment. The reference values adopted in the 25(OH)D status classification were: sufficient (>30.0 ng/ml), insufficient (20.1 ng/ml to 29.9 ng/ml), and deficient (<20.0 ng/ml) [26].

The statistical analyses were conducted with the Stata 13.1 software. The normality of the variables was evaluated using the Shapiro Wilk test. The descriptive analysis was conducted by calculating the absolute and relative frequency values of the variables.

The exploratory factor analysis was applied for the dietary pattern evaluation and the main components analysis method for the factor extraction. The Kaiser-Mayer-Olkin coefficient (KMO) and the Bartlett sphericity tests were conducted before the factor analysis to verify the applicability of the statistical analysis. The factors with values above 1.9 were retained and the exploratory factor structure was obtained based on the indicators with factor loadings higher than 0.20. This chosen cut-off point has already been applied in studies of dietary patterns, and collaborates with a less restrictive number of food items [27,28].

To verify the association between the mineral content and the dietary patterns, linear regression models were built, adjusted by the following variables: age, education, smoking, menopause, body mass index, and vitamin D level in the blood.

The analysis was weighted by sex, age, and education, according to population data, considering the effect of the sampling design, using the "*svy*" group of commands [29].

## RESULTS

Of the 678 research participants, most were female (50.10%) and 26.0% of the individuals were between 30 and 39 years old. In relation to education, 69.40% stated that they had studied for eight years or longer. 64.3% of women reported not being in menopause. Regarding the behavioral variables, 65.1% said that they did not smoke. In relation to the BMI, the general mean found was 25.7 kg/m² (95% CI: 25.0-26.3), with the highest percentage being for individuals classified as having a normal weight (58.60%), and for vitamin D level in the blood, the mean value found was 30.0 ng/ml (95% CI: 28.6-31.4) (Table 1). The mean value of bone mineral content for the evaluated population was 2.68 g (95% CI: 2.63-2.73) (Chart 1).

The assessment of the correlations between the food items and the sample fit in the factor analysis to identify the dietary patterns were satisfactory for the exploratory factor analysis (KMO=0.746 and Bartlett sphericity <0.001). After the varimax orthogonal rotation, eight components were found. Two had eigenvalues above 1.9, which explained 17.81% of the variance of the components, representing two dietary patterns. It was observed that the food items olives and corn, as well as Dough-based food, presented negative loading for the food pattern characterized as "local traditional". The commonality varied from 0.33 to 0.67 and the indicators with higher loadings than 0.20 (indicated in bold) were considered valid to remain in each component (Table 2).

The dietary patterns were designated as "meats and alcoholic drinks", characterized by the presence of olives and corn, sandwiches, red meat, condiments, cured meat, alcoholic drinks, dough-based foods,

**Table 1** – Sociodemographic and behavioral characteristics of the study population. *Viçosa* (MG), Brazil, 2012-2014.

| Variables | General | | Male | | Female | |
|---|---|---|---|---|---|---|
| | Proportion (%) | 95% CI | Proportion (%) | 95% CI | Proportion (%) | 95% CI |
| Age group (years) | | | | | | |
| 20-29 | 24.01 | 16.68-33.27 | 28.35 | 18.43-40.93 | 19.69 | 13.48-27.84 |
| 30-39 | 26.00 | 21.60-30.93 | 26.85 | 20.51-34.30 | 25.14 | 20.40-30.56 |
| 40-49 | 24.33 | 19.36-30.10 | 21.98 | 15.23-30.65 | 26.67 | 21.05-33.16 |
| 50-59 | 25.64 | 20.30-31.83 | 22.80 | 16.22-31.07 | 28.47 | 22.28-35.60 |
| Education (years) | | | | | | |
| 0-3 | 13.67 | 7.61-23.34 | 11.75 | 4.21-28.76 | 15.59 | 8.94-25.78 |
| 4-7 | 16.85 | 12.36-22.56 | 15.37 | 9.86-23.16 | 18.33 | 12.32-26.39 |
| ≥8 | 69.46 | 58.23-78.77 | 72.87 | 56.82-84.57 | 66.07 | 55.64-75.14 |
| Menopause | | | | | | |
| Yes | 35.67 | 29.79-42.02 | – | – | 35.67 | 29.79-42.02 |
| No | 64.32 | 57.97-70.20 | – | – | 64.32 | 57.97-70.20 |
| Smoking | | | | | | |
| Smoker | 12.59 | 9.63-16.30 | 14.88 | 9.31-22.94 | 10.32 | 7.46-14.11 |
| Ex-smoker | 22.29 | 16.15-29.92 | 23.30 | 13.60-36.95 | 21.08 | 15.58-28.36 |
| Non-smoker | 65.10 | 57.85-71.72 | 61.81 | 50.09-72.30 | 68.39 | 60.76-75.14 |
| Nutritional state | | | | | | |
| Eutrophic | 58.60 | 51.15-65.68 | 59.76 | 50.56-68.31 | 57.46 | 47.25-67.07 |
| Overweight | 41.39 | 34.31-48.84 | 40.23 | 31.68-49.43 | 42.53 | 32.92-52.74 |
| Vitamin D | | | | | | |
| Sufficient | 37.68 | 32.84-42.78 | 35.32 | 28.63-42.63 | 40.03 | 34.89-45.39 |
| Insufficient | 48.58 | 32.84-42.78 | 55.41 | 46.91-63.61 | 41.78 | 34.34-49.61 |
| Deficient | 13.73 | 10.69-17.45 | 9.25 | 6.51-12.99 | 18.18 | 13.30-24.34 |

Note: CI: Confidence Interval.

**Chart 1** – Food groups from the food frequency questionnaire used in the factor analysis. *Viçosa* (MG), Brazil, 2012-2014.

| Food groups | Food items from the food frequency questionnaire |
|---|---|
| Soups | Vegetable soup, broth |
| Olives, corn | Olives, corn |
| Popcorn | Popcorn |
| Sandwiches | Ham and cheese sandwiches, hamburgers |
| Red meat | Beef or pork, meatballs, patties |
| White meat | Chicken, fish |
| Eggs | Eggs (boiled, scrambled, fried) |
| Beans, trooper's beans, *feijoada* | Beans, trooper's beans, *feijoada* |
| Margarine, butter, mayonnaise, olive oil | Margarine, butter, mayonnaise, olive oil |
| Condiments | Garlic paste, garlic, onion, seasoning, stock, ketchup, mustard |
| Fruits | Pineapples, melons, watermelons, oranges, tangerines, guavas, peaches, mangoes, bananas, apples, pears, papayas, grapes, strawberries, plums, fruit salads, fruit juices in general |
| Milk, cheese, yoghurt | Whole milk, semi-skimmed milk, skimmed milk, cheese, yoghurt |
| Cured meat | Mortadella, ham, salami, sausage |
| Greens | Lettuce, chicory, cabbage, cress, rocket, zucchini, chayote, okra, broccoli, cauliflower, beetroot, carrot, pumpkin, tomato, vinaigrette |
| Alcoholic drinks | Beer, wine, liquor, cachaça, whisky, brandy |
| Coffee and tea | Coffee and tea |
| Soft drinks and artificial juices | Soft drinks and artificial juices |
| Dough-based food | Pasta (macaroni, noodles, lasagna), pizza |
| Cereals | Porridge, white rice, mash, *farofa*, English or sweet potato, boiled cassava, oats, granola, cereal bars |
| Savory snacks | Fried and roasted savory snacks |
| Cookies | Sponge and cookies |
| Bread | Bread, cheesy bread, toasted bread |
| Sweets and chocolate | Sweets in general, candy, chocolates |

**Table 2** – Dietary patterns and factor loading of the dietary patterns derived from the analysis of the main components. *Viçosa* (MG), Brazil, 2012-2014.

| Food Groups | Dietary Patterns | | Commonality |
|---|---|---|---|
| | Meats and alcoholic drinks | Local traditional | |
| Soups | -0.141 | **0.203** | 0.3609 |
| Olives and corn | **0.218** | **-0.244** | 0.5414 |
| Popcorn | 0.054 | 0.113 | 0.5834 |
| Sandwiches | **0.580** | -0.142 | 0.5178 |
| Red meat | **0.529** | **0.319** | 0.6186 |
| White meat | 0.057 | 0.093 | 0.4738 |
| Eggs | **0.209** | **0.256** | 0.5247 |
| Beans, trooper's beans | 0.071 | **0.751** | 0.4782 |
| Margarine, butter, oil | **0.204** | **0.303** | 0. 4974 |
| Condiments | **0.223** | **0.201** | 0.5228 |
| Fruits | -0.057 | -0.017 | 0.6797 |
| Milk, cheese, yoghurt | 0.012 | -0.039 | 0.5911 |
| Cured meat | **0.664** | 0.174 | 0.5629 |
| Greens | 0.037 | 0.075 | 0.6198 |
| Alcoholic drinks | **0.585** | 0.072 | 0.4959 |
| Coffee and tea | -0.084 | **0.345** | 0.3334 |
| Soft drinks and artificial juices | 0.065 | 0.155 | 0.6035 |
| Dough-based food | **0.471** | **-0.228** | 0.6131 |
| Cereals and tubers | 0.061 | **0.789** | 0.4911 |
| Savory snacks | **0.529** | 0.117 | 0.6614 |
| Cookies | 0.043 | 0.170 | 0.5117 |
| Bread | 0.109 | 0.027 | 0.6419 |
| Sweets and chocolate | 0.163 | -0.034 | 0.5890 |
| Eigenvalues | 2.180 | 1.914 | |
| % explained variance | 9.48 | 8.33 | |
| % cumulative explained variance | 9.48 | 17.81 | |

Note: Indicators with factorial loads less than -0.20 or greater than 0.20 are in bold.

and savory snacks, which accounted for 9.48% of the variance of food consumption; and "local traditional", composed of eggs, beans and trooper's beans, margarine, butter, and olive oil, coffee and tea, and cereals and tubers, which explained 8.33% of the variance of food consumption (Table 2).

In relation to the association between the dietary patterns and the BMC, after adjustments for age, education, smoking, BMI, and blood vitamin D level, it was verified that for the male sex, the second dietary pattern, characterized as "local traditional", was positively associated with the BMC ($p$=0.036), showing that the higher the factor loading retained in this pattern, the higher the BMC. Thus, for every unit of factor loading increased in the local traditional pattern, there is an improvement of 0.058 g of the BMC. For the female sex, after making the same adjustments, the first dietary pattern, characterized as "meats and alcoholic drinks," was inversely associated with the BMC ($p$=0.037) (Table 3).

**Table 3** – Associations between dietary patterns and bone mineral content. *Viçosa* (MG), Brazil, 2012-2014.

| Dietary patterns | Bone mineral content (g) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\beta$ | 95% CI | *p*-value | $\beta$ Aj* | 95% CI | *p*-value** | $\beta$ | 95% CI | *p*-value | $\beta$ Aj* | 95% CI | *p*-value** |
| Meats and alcoholic drinks | 0.087 | 0.018;0.156 | 0.013 | 0.013 | -0.048;0.075 | 0.668 | 0.034 | -0.026;0.094 | 0.264 | -0.057 | -0.110;-0.003 | **0.037** |
| Local traditional | 0.014 | -0.054; 0.083 | 0.679 | 0.058 | 0.003;0.112 | **0.036** | -0.033 | -0.078; 0.0011 | 0.144 | -0.010 | -0.051;0.030 | 0.624 |

Nota: *Models adjusted for age, education, smoking, menopause, body mass index, and vitamin D level in the blood. ***p*-value: linear regression adopting significance for $p<0.05$. $\beta$: values adjusted by covariables; CI: Confidence Interval.

## DISCUSSION

After adjusting for sociodemographic, anthropometric, and behavioral factors and for serum vitamin D concentration, we identified different associations between bone health and dietary patterns in relation to sex. For males, bone health was positively associated with the dietary pattern characterized as "local traditional", while for females there was an inverse association with the pattern "meat and alcoholic beverages".

Other studies also identified a positive association between the "local traditional" dietary pattern and bone health in men. However, they presented different foods as making up the dietary pattern. Research carried out with men identified that the "prudent eating" pattern, characterized by abundant consumption of vegetables, salad, and non-fried fish, is positively associated with bone health [13]. Another study, carried out with adults (18 to 45 years old), of both sexes, identified a positive association for men between a fiber-rich dietary pattern and low back bone health [30]. A systematic review with meta-analysis that sought to verify the associations of dietary patterns with bone density in adults, suggested that 'healthy' diets are beneficial. More importantly, having a 'healthy' dietary pattern may help reduce the risk of hip fracture [10]. It is observed that the dietary patterns identified in the studies are characteristic of the researched places, emphasizing the influence of culture and regionality on food consumption. The dietary pattern here called "local traditional" is composed of accessible, easy-to-find and low-value foods, as is characteristic of the Brazilian population. This is also an important contribution of this study, since non-pharmacological treatments, such as diets, are important alternatives for public policy actions to prevent diseases, including those related to bone health.

Among women, it is no different. Research carried out with Greek women identified that a dietary pattern characterized by the high consumption of fish and olive oil and low consumption of meat was positively related to bone health [31,32]. A study carried out with post-menopausal Brazilian women with a

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diagnosis of osteopenia or osteoporosis, found a negative association between bone health and excessive intake of sweet foods and caffeinated beverages [18].

The pattern referred to here as "meat and alcoholic beverages" is close to what the literature refers to as a "Western diet", with retention of a higher factor loading for foods with high energy density, rich in fats and sugar and alcoholic beverages. A study carried out with Japanese women, in an analysis adjusted for confounding factors such as age, smoking, menarche, parity, use of hormone therapy, and history of fractures, identified a tendency for an inverse association between this type of dietary pattern and bone health, which corroborates the present study [33]. In another study, also with women, five different dietary patterns were identified [34]. Of these, only two showed consistent associations in the adjusted models, with the pattern with high consumption of cereals, high energy-dense foods, and processed meats being inversely associated with the BMC, a result that is also related to the one presented here [34]. Thus, we suggest that this dietary pattern is not favorable to women's bone health and may increase the risk of fractures at advanced ages, as it may lead to reduced bone mass [1,10,35].

Although there is a trend of negative association between the "meat and alcoholic beverages" dietary pattern and bone health, some nutrients retained in this study deserve further discussion and caution, such as alcoholic beverages and foods with a high energy value. Regarding alcohol consumption and bone health, studies are inconsistent [36]. In some studies, light or moderate consumption of alcohol is seen as a protective factor, while in others moderate and high consumption is associated with poor bone health [37-40]. Regarding the consumption of foods with a high energy value, the literature presents some important considerations [15,41-43]. Epidemiological studies have identified that excessive consumption of fat, especially saturated fatty acids, is inversely associated with bone health [40,43]. On the other hand, in a study carried out with Canadian adults of both sexes, a positive association was found between both high energy-dense foods and high BMIs and bone health [42]. There are studies that indicate that the consumption of high-energy foods, although unhealthy, can lead to a change in body composition, such as an increase in the BMI, which would imply good bone health, as excessive body mass increases the mechanical load, which in turn activates bone metabolism [42,44]. In contrast, some studies have indicated that excess body and abdominal adiposity are strong predictors of low vitamin D levels in the blood, a fundamental agent of bone metabolism [45,46]. Additionally, there is evidence that there are receptors in adipose tissue that cause the retention of this vitamin [47,48]. These contradictions show the need for research.

The study's limitations include its cross-sectional nature, which blocks the temporality of the associations found, and the inherent errors in food surveys, such as difficulties in estimating food portions and remembering food consumption. However, one of its strengths is the fact that it is a population-based study, carried out with the Brazilian population, which allows extrapolating the results to the population studied and establishing analogies for other regions that have similar characteristics, as well as the use of a food frequency questionnaire developed and validated for the population studied.

## CONCLUSION

Our study establishes a positive association between the "local traditional" dietary pattern and adequate bone health in men, emphasizing that such diet can and should be used in the prevention of diseases related to bone health. We also identified an inverse association between the dietary pattern characterized as "meat and alcoholic beverages" and bone mass in women.

A C K N O W L E D G M E N T S

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C O N T R I B U T O R S

KJ SEGHETO, DCG SILVA and GZ LONGO contributed to the conception and design, analysis and interpretation of the data, review and approval of the final version of the article. FG FERREIRA contributed to the conception and design, analysis and interpretation of the data, review and approval of the final version of the article. ELGM JORGE and DLM PEREIRA was responsible for the analysis and interpretation of the data, review and approval of the final version of the article.

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