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Is There a Correlation between Adults with Higher Bone Weight and Obesity Since Childhood? A Cross-Sectional Study with a Convenience Sample

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ABSTRACT

Objective: The lifetime body weight gain can physiologically function influence that include bone mass increase due tension levels in the bone, because of the greater the weight the higher the level of tension in the bone. This way, obesity may lead to an increase in bone density because it is associated with higher mechanical loads, i.e., adults with obesity can had significantly higher bone mineral density than healthy-weight adults. But do adults diagnosed through body mass index with obesity who reported obesity since childhood and that also reported lifetime body weight gain compared to adults without obesity, without reported obesity since childhood and without reporting lifetime body weight gain, may have higher bone weight? This is the main question that this work tries to answer by evaluating self-reported obesity and weight gain, including data on age, height, body weight and bone weight.

Methods: Between 08/01/2022 and 08/09/2022 a total of 36 participants were randomly selected by the author. The present work is a cross-sectional study using convenience sample. After some criteria were previously established, the selected participants were then divided into two groups, experimental group (O; Obese; n=18) and control group (NO; Non-Obese; n=18). Including, all participants signed a free and declared consent form for the subsequent evaluation of their data.

Results: The experimental group participants (O; n=7) had (Mean ± Standard Deviation) 29.7 ± 4.5 years, 180 ± 4.6 cm, 111.1 ± 7.0 kg of body weight and 14.3 ± 0.6 kg of bone weight, and control group participants (NO; n=5) were 33.8 ± 2.7 years old, 173.4 ± 5.4 cm, 84.8 ± 4.4 kg of body weight and 11.7 ± 0.35 kg of bone weight. From the statistical analysis of the participants' data, there was no statistical significance for age ($p>0.05$; $R_1=37$). However, statistical significance was found for height ($p \leq 0.05$; $R_1=57$), body weight ($p \leq .05$; $R_1=63$) and bone weight ($p \leq 0.05$; $R_1=63$).

Conclusion: Obese men may have increased bone weight likely related to lifetime obesity when compared to non-obese men without lifetime obesity.

Keywords

Obesity, Bone mass, Body weight, Non-obese, Density

Introduction

The skeleton is a complex multifunctional organ system made up of 206 bones [1]. Lifetime body weight gain can physiological functions influence that include bone mass increase due tension levels in the bone [2]. This tensions can positively result in an increase in bone mass by tension level applied to the body, such as an example a simples walk that can imposes on the body a load of approximately 1.5 × body weight [3] and have a ratio of the greater the weight the higher the level of tension in the bone [4], i.e. the mechanical loading, as expected, exerts positive effects on bone mass. This way, obesity may lead to an increase in bone density because it is associated with higher mechanical loads, which can protect bone against abrupt weight gain with an higher bone forming, i.e. adults with obesity can had significantly higher bone mineral density than healthy-weight adults [5], also in children, the fat mass demonstrated have beneficial effect on bone mass acquisition [6]. On the other hand, the load absorbed during an impact exercise, like a jump for example, also has been shown to be effective in increasing bone mass in children by increasing bone size [7]. Therefore, how individuals with obesity presented higher bone mineral density, better hip geometry and greater strength compared with normal-weight controls [8], the aim of this study is to observe whether adults diagnosed through Body Mass Index (BMI) [9] with obesity (BMI ≥ 30 kg/m^2) who reported obesity since childhood (BMI ≥ 97th percentile) and that also reported lifetime body weight gain (an average of 10 kg for each year) compared to adults without obesity (BMI ≤ 29.9 kg/m^2), without reported obesity since childhood (BMI ≤ 97th percentile) and without reporting lifetime body weight gain, may have higher or lower bone weight. Besides that, to know if this could demonstrate a possible correlation of obesity with increased bone weight on these adults.

Methods

Study Design and Subjects

Between 08/01/2022 and 08/09/2022 a total of 36 participants

were randomly selected by the author, a registered nutritionist by the Regional Nutrition Council N° 13266-Fortaleza, Ceará, Brazil. Although there was no sample calculation, the present work is a cross-sectional study using convenience sample. The research follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement guidelines for reporting observational studies. Besides that, some criteria were previously established, in which participants who will be selected for the experimental group should meet; adult patients (≥ 18 years), obesity diagnosis (BMI ≥ 30 kg/m^2), self-reported obesity since childhood (BMI ≥ 97th percentile), here the author previously investigated, during the nutritional appointment, the approximate weight self-report during the 5, 10 and 15 years, and self-report lifetime body weight gains no pre-set date. Consequently, the exclusion criterion would be not meeting any of the inclusion criteria. The first criterion (being an adult) was applied to all participants. For control group participants (non-obese), the other criteria would not need be met. However, non-obese participants who reported obesity only during childhood would also be excluded from the analyses. An exclusion criterion applied was the presence by self-report of some comorbidity (such as osteopenia and sarcopenia, for example) that could influence the loss of bone mass. Finally, selected participants were then divided into two groups, experimental group (O; Obese; n=18) and control group (NO; Non-Obese; n=18). Including, all participants should sign a free and declared consent form for the subsequent evaluation of their data, that was a free and informed written consent according to declaration of Helsinki (ethical principles for medical research involving human subjects).

Anthropometric Measurements

The weight was collected using an In Body ® 120 scale, height was measured using a MD-2M-Center Medical ® stadiometer. The skinfolds were measured using a Sanny ® AD1011-LDC adipometer using the 4-fold protocol (Petroski), thus, the folds required by the protocol were collected and placed in the formula [Male subjects=1.10726863–0.00081201(subscapularis +triceps+suprailiac+medial calf)+0.00000212 (subscapularis+tri ceps+suprailiac+medial calf)–0.00041761 (age in years); and Female subjects=1.19547130–0.07513507*Log_{10} (middleaxillar y+suprailiac+thigh+medial calf)–0.00041072 (age in years)] to calculate the fat-free mass and the body fat percentage [10]. The bone weight was established by measuring the wrist and femur bone diameters with the AVA Nutri ® bone caliper and was calculated using the Von Döbeln equation [(bone weight=height^2 × wrist diameter × femur diameter × 400) 0.712 × 3.02].

Statistical analysis

The total study's sample was divided into Obese (O) and Non-Obese (NO) patients. The test used was Wilcoxon's t test that replaces Student's t test for paired samples when the data do not meet the requirements of the latter, being a non-parametric method for comparing two paired samples and used to compare related samples when they do not follow a normal distribution [11]. Thus, the alternative hypothesis was O ≠ NO, the null hypothesis was O=NO and the significance level was 0.05 for to be used in the two-tailed Wilcoxon test and to assess whether there is statistical significance assuming the R_1 critical region $(-\infty,33] \cup [56, \infty)$. The values will be displayed in a subjects' characteristics table including age, height, body weight, and bone weight, and data with statistical significance from the test described above will be marked with an asterisk.

Results

Of the total sample, all 36 selected participants were adults and therefore eligible for the first criteria mentioned in the methodology. Of the eighteen participants in the experimental group (9 women and 9 men; Obese; n=18), three (2 women and 1 man) did not report obesity since childhood, six (4 women and 2 men) did not want to sign any informed consent, two (2 women) reported recent case of osteopenia and two (1 women and 1 man) reported recent abrupt weight gain, lifetime body weight gain no pre-set date, and were then excluded from the study, this left a total of seven adult men who passed the criteria and were included for further analyses. Of the eighteen participants in the control group (4 women and 14 men; non-obese; n=18), seven (3 women and 4 men) did not want to sign any informed consent and six (1 women and 5 men) reported obesity during childhood but not in adulthood, what left a total of five adult men who passed the criteria and were included for further analyses. Finally, twelve men agreed to participate this study, met the inclusion criteria, and were then selected for further analyses with sample being divided into two groups; obese (O; n=7) and non-obese (NO; n=5).

The anthropometric data collected in the present study are shown in Table 1. The experimental group participants (O; n=7) had (Mean ± Standard Deviation) 29.7 ± 4.5 years, 180 ± 4.6 cm, 111.1 ± 7.0 kg of body weight and 14.3 ± 0.6 kg of bone weight, and control group participants (NO; n=5) were 33.8 ± 2.7 years old, 173.4 ± 5.4 cm, 84.8 ± 4.4 kg of body weight and 11.7 ± 0.35 kg of bone weight. From the statistical analysis of the participants' data, there was no statistical significance for age ($p>0.05$; $R_1=37$). However, statistical significance was found for height ($p \leq 0.05$; $R_1=57$), body weight ($p \leq 0.05$; $R_1=63$) and bone weight ($p \leq 0.05$; $R_1=63$). The Wilcoxon signed rank test shows that the observed difference between both measurements is significant. In summary, there is reject the null hypothesis that both samples have from the same bone weight, and we might assume that the obese men with lifetime body weight gain have higher bone weight compared to non-obese men without lifetime body weight gain.

Table 1. Subjects' characteristics.

	Obese participants (O; n=7)	Non-obese participants (NO; n=5)
Age (years)	29.7 ± 4.5	33.8 ± 2.7
Height (cm)	180 ± 4.6*	173.4 ± 5.4
Body Weight (kg)	111.1 ± 7.0*	84.8 ± 4.4
Bone Weight (kg)	14.3 ± 0.6*	11.7 ± 0.35

Data are mean ± SD
*Significant difference when compared O with NO ($p \leq 0.05$).

Discussion

During a recent narrative review, the authors speculated about the relationship into individual's body weight and their bone

weight. As conclusion they said weight-dependent loading of the skeleton plays an important role in bone weight due to altered body weight induce an adaptive skeletal response [2], something related to mechanical loading. Because, according to another recent narrative review the obesity have potential positive effects of mechanical loading conferred by increased body weight [4] that perhaps influence the increase in bone weight in obese individuals. Besides that, another recent publication, a systematic review, and meta-analysis, explained data collected from more than 2900 individuals to assess the relationship into bone mineral density between obese and non-obese and as a conclusion, this mechanical influence in bone through body weight exerts positive effects on bone mass, some action that produces more bone according to how much mechanical impact is applied from weight to bone. This way, obesity may lead to an increase in bone density because it is associated with higher mechanical loads. Therefore, adults with obesity can had significantly higher bone mineral density than healthy-weight adults, as was recently proven [5]. In summary, the present study findings associate lifetime obesity with a change in the bone weight, which in a way, corroborates with the works ideas brought for this discussion, two narrative review and one systematic review and meta-analysis. It is something that seems to be related to the mechanical impact that bone suffers due weight gain during life or lifetime obesity. However, the present work as well as the other works exposed for this discussion, do not bring to the certainty which physiological mechanism acts directly in this alteration, being necessary further randomized clinical trials to better elucidate this issue.

Conclusion

Obese men may have increased bone weight likely related to lifetime obesity when compared to non-obese men without lifetime obesity. However, more studies like this one using a larger sample, including women, in addition to randomized clinical trials, are needed to better elucidate these findings.

Practice Implications

Few articles approach this topic in a clinical way. Therefore, more studies like this one should be carried out to better explore a possible correlation between lifetime body weight gain and increased bone weight.

This research may encourage researchers to carry out controlled clinical studies with a larger sample to elucidate and better support the conclusions mentioned here.

It is important to understand that a patient with lifetime body weight gain may have greater bone weight and that this may influence their BMI margin for diagnosing obesity degrees. In addition, it can refute the "ideal weight" margin stipulated, in which the weight that must be achieved by the patient in weight loss tends to be a weight that is very difficult weight to be achieved due to the increased weight threshold because lifetime body weight gain.

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Conflict of Interest

The author declare that they have no competing interests.

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