Do people with overweight have bigger bones?
Body mass index (BMI) and the size of the femoral head

Czy otyli ludzie mają większe kości?
Wskaźnik masy ciała (BMI) a średnica głowy kości udowej

Dawid Ciechanowicz, Aleksander Wesołowski, Łukasz Kołodziej

Department of Orthopaedics, Traumatology and Orthopaedic Oncology, Pomeranian Medical University of Szczecin, Szczecin, Poland

Abstract

Introduction. The study checked whether there is a relationship between an easily accessible parameter like Body mass index BMI and the diameter of the femoral head.

Material and methods. The data of 47 consecutively surgically treated patients from the Department of Orthopedics, Traumatology and Oncology of the Motor Mechanism of the Pomeranian Medical University who underwent total hip arthroplasty were analyzed. Patients were divided into two groups: group I – 26 women and group II – 21 men. The diameter of the femoral head was measured intraoperatively with a caliper. Body weight and height were measured the day before the planned surgery.

Results. Average age - 65.77 (± 13.84) years in women, 65.95 (± 11.61) years in men. Mean BMI - 27.57 (± 4.14) in women, 28.86 (± 4.80) in men. In group I (21 men) there was no statistically significant correlation between BMI and femoral head diameter (p = 0.305). However, there was a strong positive correlation (r = 0.6279, p = 0.02) between the height and diameter of the femoral head. In Group II (26 women), a moderately positive correlation (r = 0.4301, p = 0.028) was found between BMI and the diameter of the femoral head. In addition, there was a strong positive correlation between the diameter of the femoral head and height (r = 0.6873, p = 0.001) and body weight, and the diameter of the femoral head (r = 0.5904, p = 0.01).

Conclusions. Men in comparison to women, despite similar mean BMI and age, had statistically significant (p = 0.000003) higher mean size of femoral head – diameter of femoral head in women = 47.65 (± 3.91) and men, 53.19 (± 2.74). Increased BMI suggests that the diameter of the femoral head is also larger, but only in women. However, a more universal parameter is growth because it showed a strong positive correlation with the value of the diameter of the femoral head in both the group of women and men.

Key words: BMI, size of femoral head

Streszczenie

Wstęp. Badanie sprawdzało czy istnieje zależność między łatwo dostępным parametrem jak Wskaźnik masy ciała (Body mass index) BMI a średnicą głowy kości udowej.


Wyniki. Średnia wieku – 65,77 (±13,84) lat u kobiet, 65,95 (±11,61) lat u mężczyzn. Średnie BMI – 27,57 (±4,14) u kobiet, 28,86 (±4,80) u mężczyzn. W grupie I (21 mężczyzn) nie wykazano istotnej statystycznie korelacji między BMI, a średnicą głowy kości udowej (p = 0,305). Jednakże wystąpiła silna dodatnia korelacja (r = 0,6279, p = 0,02) między wzrostem, a średnicą głowy kości udowej. W grupie II (26 kobiet) wykazano umiarkowanie dodatnią korelację (r = 0,4301; p = 0,028) między BMI, a średnicą głowy kości udowej. Dodatkowo wystąpiła silna dodatnia korelacja między średnią głowy kości udowej, a wzrostem (r = 0,6873, p = 0,0001) oraz masą ciała, a średnią głowy kości udowej(r = 0,5904, p = 0,01).

Wnioski. Mężczyźni w porównaniu do kobiet, pomimo zbliżonej wartości średniej BMI i wieku, mieli statystycznie istotnie (p = 0,000003) większą średnią wielkość głowy kości udowej – średnica głowy kości udowej odpowiednio u kobiet = 47,65 (±3,91) i mężczyzn 53,19 (±2,74). Zwiększone BMI pozwala sądzić, że średnica głowy kości udowej jest również większa, ale jedynie u kobiet. Jednak bardziej uniwersalnym parametrem jest wzrost gdyż wykazał on silną dodatnią korelację z wartością średnicy głowy kości udowej zarówno w grupie kobiet jak i mężczyzn.

Słowa kluczowe: BMI, średnica głowy kości udowej
Introduction

Obesity and overweight is an increasing health problem in Poland [1]. Increased body weight can lead to hypertension, heart disease, as well as more frequent occurrences of colon, pancreas or liver cancer [2]. It is also known that obesity and overweight are predisposing conditions for osteoarthritis of the knee and hip [3,4]. However, it has not been clearly explained whether people with an increased body weight have a larger bone diameter compared to people with normal BMI values. Therefore, we decided to investigate whether there is a relationship between an easily accessible parameter such as the Body Mass Index (BMI) and the diameter of the femoral head. In addition, the aim of the study was to examine whether any of the parameters needed to calculate BMI, that is, height [m] and body weight [kg], has a greater impact on the femoral head diameter, and also check whether men have a statistically significantly larger diameter of the head bone femoral compared to women.

Materials and methods

To test this hypothesis, 47 patients from the Orthopedics, Traumatology and Oncology Clinic of the Pomeranian Medical University were qualified for the study and underwent surgery of total cementless hip arthroplasty. The diameter of the femoral head was routinely measured by the operator intraoperatively with a caliper. Body mass and height are mandatory measurements performed by nursing staff on the day before the planned surgery using a weighting machine and a measuring rod.

Statistic methods

In order to assess the dependence of body weight [kg], height [m], BMI and femoral head diameter [mm], a correlation matrix was performed using the Statistica program. The matrix is to show whether there are dependencies between the data and whether they are positive or negative. First, a correlation matrix for all subjects was performed, and then the patients were divided into two groups: group I – 26 women and group II – 21 men. The division was dictated by differences in the hormones, bone structure, fat and muscle tissue distribution of women and men. A T-test for independent data was also performed to compare the diameter of the femoral head between men and women.

Results

The average values of anthropometric measurements and the average size of the femoral head in both groups of patients are presented in the tables (Tab. 1, Tab. 2).

Table 1. Mean values (± standard deviation) in group I.

<table>
<thead>
<tr>
<th>Group I</th>
<th>Średnia±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age [years]</td>
<td>65,77±13,83</td>
</tr>
<tr>
<td>Weight [kg]</td>
<td>72,85±13,88</td>
</tr>
<tr>
<td>Height [m]</td>
<td>1,62±0,06</td>
</tr>
<tr>
<td>BMI</td>
<td>27,57±4,22</td>
</tr>
<tr>
<td>The diameter of the femoral head [mm]</td>
<td>47,65±3,99</td>
</tr>
</tbody>
</table>

Table 2. Mean values (± standard deviation) in group II.

<table>
<thead>
<tr>
<th>Grupa II</th>
<th>Średnia±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age [years]</td>
<td>65,95±11,90</td>
</tr>
<tr>
<td>Weight [kg]</td>
<td>89,79±17,64</td>
</tr>
<tr>
<td>Height [m]</td>
<td>1,76±0,07</td>
</tr>
<tr>
<td>BMI</td>
<td>28,86±4,92</td>
</tr>
<tr>
<td>The diameter of the femoral head [mm]</td>
<td>53,19±2,80</td>
</tr>
</tbody>
</table>

The correlation matrix of the studied parameters without division into groups showed a positive correlation between BMI (0.3541), body weight (0.6435) and height (0.8003), and the diameter of the femoral head (Tab. 3). In the next stage, patients were divided into two groups – Group I (Women, 26 patients) and Group II (Men, 21 patients). Next, a T-test for independent data was performed to compare the diameter of the femoral head between men and women. He showed that the group II, in spite of the similar mean BMI and age to group I, had a statistically significant (p = 0.000003) higher (about 11.63%) mean size of the femoral head.

Group I showed a positive correlation (0.4301, p = 0.028) between BMI and the diameter of the femoral head. In addition, there was a positive correlation between the diameter of the femoral head and the height (0.6873, p = 0.0001) and body weight (0.5904, p = 0.01) (Tab. 3). Chart I shows the spread of data that may affect the strength of correlation in group I (between BMI and the diameter of the femoral head), which is why it speaks more in favor of moderately stronger than a strong correlation coefficient (Fig. 1).
In people with an increased BMI value, higher rates of hip pain which in time causes pain and increases the risk of injury [7]. That their ligaments of the hip (ilio-femoral, sciatic-femoral) and in the L-S spine and pelvis during normal activities. It causes in a standing and sitting position, which forces them to flexion that obese people have a reduced ability to lean forward, both only in the group of women [6]. Gillard and Smith emphasized positively correlates with their structure and has been confirmed Cao indicates that the higher bone load caused by obesity positively correlates with the value of the diameter of the femoral head in both the group of women and men. Bourne and colleagues showed that increased BMI correlates with higher risk of hip joint damage and hip arthroplasty, we confirmed this relationship, because in our study group, which was not selected due to body weight, the mean BMI was> 27 in both groups [9]. It has not been clearly explained how adipose tissue and increased body weight affect bone health [10,11]. On the one hand, obese people have chronic inflammation that predisposes bone osteolyis, which leads to the development of osteoporosis [10]. On the other hand, increased body mass, and hence greater load on the hip joint may have a positive effect on the femoral neck [12]. Our study did not check the effect of body mass on bone density and structure, only on its thickness. However, we have not shown that overweight or obese people had a statistically significant diameter of the femoral head compared to people with normal BMI. Nevertheless, a positive correlation between BMI and diameter may indicate that a significant difference would be possible in the case of expanding the group of respondents. What is the advantage of using BMI, i.e. the ease and speed of obtaining a result by determining only two, easily measurable parameters, is also its biggest disadvantage. Exceeding the norms of the BMI index serves only to estimate the risk of developing many civilization diseases, but it is not highly specific to any of them [13, 14]. It is not modified because of, for example, sex, age, structure and body structure. Increased weight is not always an increased amount of body fat, it would be difficult to classify a bodybuilder to obese people. [15] Due to the imperfections of the method, the BMI index should be used individually and be cautious in the case of athletes or the elderly, due to the often accompanying osteoporosis.

Conclusions

Based on the results of the study, it can be concluded that there is a strong positive relationship between the height and diameter of the femoral head in both groups. There is also a moderate positive relationship between BMI and femoral head diameter and body mass, and the diameter of the femoral head, but only in the female group. Men with a similar BMI and age in relation to women have a statistically larger diameter of the femoral head. Weight and height of the patient used to calculate the BMI index are parameters easily available to the physician of each specialty, therefore knowledge of a strong correlation with the diameter of the femoral head may be used in diagnosing or determining the risk of hip joint pathology. Gover and Casazza, claim that greater body mass correlates with larger bones in boys and girls [5]. Our work shows that in the case of the diameter of the femoral head, the positive correlation between body mass and diameter is visible only in the group of women. Cao indicates that the higher bone load caused by obesity positively correlates with their structure and has been confirmed only in the group of women [6]. Gillard and Smith emphasized that obese people have a reduced ability to lean forward, both in a standing and sitting position, which forces them to flexion in the L-S spine and pelvis during normal activities. It causes that their ligaments of the hip (ilio-femoral, sciatic-femoral) and muscles (pear-shaped, gluteal muscles) are excessively stretched, which in time causes pain and increases the risk of injury [7]. In people with an increased BMI value, higher rates of hip pain were also observed, which could have been caused by adaptive posture changes and a greater hip loading by body weight [7]. In our study, the mean BMI> 27, indicating that obese people were more frequently subject to hip replacement surgery. Referring to the work of Nieves et al [8], who examined whether men have larger bones than women based on the measurement of the diameter of the femoral head and femur length, we managed to confirm this study, showing a larger mean diameter of the femoral head in the group men, indicating that the BMI values in both groups were very similar. The larger diameter of the femoral head in men is probably due to the proportionately larger bone skeleton. However, the more universal parameter is the increase that is needed to calculate BMI, because it showed a strong positive correlation with the value of the diameter of the femoral head in both the group of women and men. Bourne and colleagues showed that increased BMI correlates with higher risk of hip joint damage and hip arthroplasty, we confirmed this relationship, because in our study group, which was not selected due to body weight, the mean BMI was> 27 in both groups [9]. It has not been clearly explained how adipose tissue and increased body weight affect bone health [10,11]. On the one hand, obese people have chronic inflammation that predisposes bone osteolyis, which leads to the development of osteoporosis [10]. On the other hand, increased body mass, and hence greater load on the hip joint may have a positive effect on the femoral neck [12]. Our study did not check the effect of body mass on bone density and structure, only on its thickness. However, we have not shown that overweight or obese people had a statistically significant diameter of the femoral head compared to people with normal BMI. Nevertheless, a positive correlation between BMI and diameter may indicate that a significant difference would be possible in the case of expanding the group of respondents. What is the advantage of using BMI, i.e. the ease and speed of obtaining a result by determining only two, easily measurable parameters, is also its biggest disadvantage. Exceeding the norms of the BMI index serves only to estimate the risk of developing many civilization diseases, but it is not highly specific to any of them [13, 14]. It is not modified because of, for example, sex, age, structure and body structure. Increased weight is not always an increased amount of body fat, it would be difficult to classify a bodybuilder to obese people. [15] Due to the imperfections of the method, the BMI index should be used individually and be cautious in the case of athletes or the elderly, due to the often accompanying osteoporosis.

References

Dawid Ciechanowicz et al.: Do people with overweight have bigger bones? Body mass index (BMI) and the size of the femoral head


