Influence of body mass index on patellofemoral pain

Abstract

Introduction: Patellofemoral Pain Syndrome is characterized by retro-patellar and peripatellar pain during squatting, kneeling and running whose intensity can be related to Body Mass Index (BMI). Objective: To evaluate the relationship between overweight, pain and function in women with Patellofemoral Pain Syndrome (PFPS). Method: Cross-sectional observational study of fifty-four women with PFPS assessed in the period between January and December 2015, in the physiotherapy outpatient clinic of a tertiary hospital in the city of São Paulo. To verify the variables of pain at rest, at effort and function, the Numerical Pain Rating Scale (NPRS) and the Kujala Anterior Knee Pain Scale (AKPS) were used. The participants were divided into two groups, according to the BMI categories defined by the World Health Organization (WHO): Group 1, composed of women with normal BMI (18-24.9 kg/m²), with 36 patients, and group 2 composed of overweight women (25-29.9 kg/m²), with 18 patients. Comparison between groups of pain at rest and effort and AKPS were performed using Student's t-test and Mann-Witney with statistical significance p < 0.05.
Results: There was no statistically significant difference between groups for the pain at rest and effort and for AKPS. Conclusion: BMI does not impact pain intensity and function in women with PFPS.

Keywords: Patellofemoral Pain Syndrome. Body Mass Index. Pain. Knee.

Introduction: Patellofemoral pain syndrome (PFP) is characterized by retropatellar and peripatellar pain while climbing up and down stairs, kneeling, squatting, or running, which can cause limitations to daily and sports activities [1, 2]. PFP accounts for 25% to 45% of all knee problems in active individuals [3], with higher incidence and prevalence in women [4]. Its etiology is multifactorial and may be related to direct trauma, mechanical overload at the joint, altered patellar alignment due to anatomical...
variations and muscular imbalances, degenerative changes, or a combination of these factors, affecting the distribution of forces acting on the knee joint [5, 6].

The patellofemoral joint plays a key role in the function of the knee because it increases the extensor torque by 30% in the end of the movement range and is responsible for absorbing the axial load during daily life activities, in which it can be submitted to forces equivalent to 2 to 3 times the body weight [7, 8].

The number of overweight or obese women has increased in recent years, especially in developing countries[9], making this population more susceptible to knee osteoarthritis (OA) and PFP [10], as the increase in body mass and associated metabolic factors may increase the mechanical demand and generate excessive stress on the articular cartilage of the knee, leading to a degenerative process [11, 12].

Despite the possible relationship between body weight and mechanical joint overload, the relationship between a high BMI and the development of PFP is controversial [8]. Regardless of this association, a conservative treatment approach recommends that individuals with knee pain lose weight, as this may lead to the improvement of pain and function related to this joint, as well as reduce the progression of joint degeneration [13, 14].

There is no consensus in the literature regarding the relationship between weight loss and improvement of pain and function in individuals with PFP nor are there studies that relate a high BMI to the intensity of pain and dysfunction in this population. Based on these facts, the objective of the present study was to evaluate the relationship between BMI, pain and function in women with PFP.

Methods

Study Design

Observational cross-sectional study of women with PFP that attended the physiotherapy outpatient clinic of a tertiary hospital in the city of São Paulo.

Procedures

Women diagnosed with PFP, unilateral or bilateral, by an orthopedist through clinical examination and imaging, were included in the study. All participants signed the Free and Informed Consent Term with orientation about the study, which was approved by the institution's Ethics and Research Committee (Reference no: 808.433) on October 14, 2014.

The inclusion criteria were: women aged 18 to 43 years, irregularly active according to the International Physical Activity Questionnaire (IPAQ) criteria [15], with a history of previous knee pain for at least three months and increased pain in at least two SDPF-related activities, such as going up and down stairs, jumping, squatting, or standing for a long period with the knee flexed. The exclusion criteria were male subjects, women who had any degree of gonarthrosis, or women who had undergone any type of surgical procedure in the spine or lower limbs.

Each participant had their BMI calculated by self-report of weight and height, according to Dekkers et al. [16]. For statistical purposes, participants were divided into two groups. Group 1 was composed of women with normal BMI (18-24.9 kg/m²) and group 2 was composed of overweight women (25-29.9 kg/m²) according to the World Health Organization (WHO) criteria. [17]

The pain was assessed through the numerical pain rating scale (NPRS) at rest and during effort, considered as climbing up and down stairs and squatting [18], and the knee function was assessed through the Kujala Anterior Knee Pain Scale (AKPS) [19]. The NPRS is composed of 11 points in which 0 corresponds to the absence of pain and 10 to the worst pain imaginable. The Kujala AKPS is composed of 13 items and scored from 0 to 100, the highest value corresponding to the best function.

Statistical analysis

For statistical analyses, the individuals were allocated into two groups: group 1 (G1), composed of women with normal BMI (BMI between 18-24.9 kg/m²) and group 2 (G2), composed of overweight women (BMI between 25-29.9 kg/m²). For the statistical analysis, the program R version 3.4.2 for Windows was used, with the Shapiro-Wilk and Levene tests to evaluate the normality and homogeneity assumptions and Student’s t-tests for independent samples with a normal distribution. The Mann-Whitney test was used for data with non-normal distribution. Statistical significance was considered at p < 0.05.
Results

The sample consisted of 54 women with PFP: 36 in G1 and 18 in G2. The mean age of G1 participants was 29.11 (± 8.33) years and that of the G2 participants was 28.58 (± 9.41) years. The difference between the groups in terms of the weight, height, and BMI was verified by means of the Student’s t-test for independent samples and, for age, the Mann-Whitney test was used. A statistically significant difference was observed in terms of weight and BMI. The characteristics of the subjects are described in Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>G1 (n = 36)</th>
<th>G2 (n = 18)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>29.11 (8.33)</td>
<td>28.58 (9.41)</td>
<td>0.9131</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>59.17 (7.85)</td>
<td>72.23 (5.53)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.64 (0.07)</td>
<td>1.63 (0.05)</td>
<td>0.3443</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>21.87 (2.19)</td>
<td>26.98 (2.20)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Note: y: year; kg: kilogram; m: meter; BMI: body mass index; kg/m²: kilogram/squared meter; G1: Group 1; G2: Group 2.

The difference between the means of the pain score at rest of G1 (3.67 ± 2.74) and G2 (3.64 ± 3.12) and pain during effort of G1 (6.73 ± 2.09) and G2 (6.47 ± 2) were verified by the non-parametric Mann-Whitney test; no statistically significant difference was noted between the groups. The difference between the means of the Kujala AKPS of G1 (60.77 ± 12.81) and G2 (62.79 ± 17.73) was verified through the Student's t-test for independent samples. The assumptions of this method, namely normality and homogeneity, were evaluated using the Shapiro-Wilk and Levene tests, respectively. No statistically significant difference in the comparison of these variables was noted (Table 2).

<table>
<thead>
<tr>
<th>Variable</th>
<th>G1 (n = 36)</th>
<th>G2 (n = 18)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPRS at rest</td>
<td>3.96 (2.67)</td>
<td>4.08 (3.26)</td>
<td>0.9634</td>
</tr>
<tr>
<td>NPRS during effort</td>
<td>6.68 (2.16)</td>
<td>6.69 (2)</td>
<td>0.538</td>
</tr>
<tr>
<td>Kujala AKPS</td>
<td>63.39 (11.03)</td>
<td>63.38 (16.53)</td>
<td>0.6305</td>
</tr>
</tbody>
</table>

Note: NPRS: numerical pain rating scale; AKPS: anterior knee pain scale; G1: Group 1; G2: Group 2.

Discussion

The main finding of this study was that there is no influence of BMI on the intensity of pain and knee function of women with PFP. To the best of our knowledge, this was the first study to evaluate the impact of BMI on pain and function in individuals already diagnosed with PFP. Overweight generates a systemic inflammatory condition in which cytokines known as adiposins are secreted by the adipose tissue into systemic circulation, causing inflammation of various body tissues. Adiposins, especially leptin, adiponectin, and resistin play a key role in the pathophysiology of OA [20]. Reduction of body mass enables a decrease in pain and disability associated with joint degeneration present in OA, and most guidelines recommend weight loss for symptom improvement. Studies have shown an improvement of approximately 40% in pain and function, with a 10% reduction in body mass [21, 22]. It is known that the decrease in body mass in overweight and OA subjects can lead to pain reduction, increase function, and reduce the progression of joint degeneration [11, 14, 23]. Conversely, a systematic review has shown that there is no relationship between BMI and the risk of developing PFP, both in adolescents and adults [8]. These findings are comparable to those of this study, wherein it was found that weight and BMI may not influence pain and function in the enrolled population. It is worth noting that the included subjects comprised irregularly active women who were different in terms of only weight and BMI.

Although there is a possible relationship between increased BMI and stress and structural deformation of the articular cartilage [8, 11] and weight loss, it is frequently recommended by orthopedists treating knee related dysfunctions, therapeutic strategies only addressing this relationship may not be able to affect the whole spectrum of symptoms associated with PFP as evidenced by the results obtained in this study. The chronic pain present in PFP is the result of a complex and dynamic interaction between physiological, biomechanical, and social factors that cause the persistence of or worsening condition. For establishing the most effective approach and an understanding of this condition, there is a need for a biopsychosocial investigation, aiming to globally address all aspects that may be present in pain [24, 25].

A conservative treatment approach for PFP patients takes into account the biomechanical dysfunction characterized by increased adduction and medial rotation of the hip in closed kinetic chain and delayed activation of the vastus medial in open kinetic chain and involves strengthening the muscles...
of the hip and quadriceps response to ameliorate the pain and improve function in this condition [3, 26, 27, 28]. Mechanical overload and stress on the cartilage of the patellofemoral joint may occur due to a decrease in the contact area generated by these biomechanical changes, which are independent of BMI [29].

The objective of this study was to verify if BMI influences the intensity of pain and knee function in women with PFP, by means of a transversal study. No type of treatment was proposed for the participants in this study. However, we cannot rule out that overweight has no impact on the pain and dysfunction symptoms especially when some type of treatment is proposed. Furthermore, the increase in body mass may be detrimental to the knee joint because it generates several alterations that can compromise the function and lead to significant structural changes that in the long term can necessitate joint replacement [30]. There is no correlation between overweight and the risk of developing PFP [8]. Moreover, the findings of this study demonstrate that there is no relationship between overweight and pain intensity and dysfunction present in PFP; however, there is still the possibility of overweight and obese individuals being more susceptible to OAJ development.

This study has two main limitations. Men with PFP were not evaluated as PFP is more prevalent in women. Furthermore, no individuals with a BMI above 29.9 kg/m² were evaluated. Hence the results and conclusions present in this study only account for overweight women and not for other degrees of obesity. There is thus a need for further studies to verify the influence of BMI on the conservative treatment outcomes of PFP, as well as the impact of other degrees of obesity on the magnitude of pain and dysfunction in individuals with PFP.

**Conclusion**

Higher BMI does not have an impact on pain intensity and function in irregularly active women with PFP.

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**References**


