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ORIGINAL RESEARCH

Association between body mass index and pressure biofeedback assessed core muscle function in patients with knee osteoarthritis: A registry-based pilot study

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ABSTRACT

Background: Knee osteoarthritis (OA) is a major cause of pain and disability, and excess body weight and muscle dysfunction are potentially modifiable contributors to disease burden. Trunk muscle function may influence lumbopelvic control and lower-limb mechanics, but the relationship between body mass index (BMI) and deep abdominal muscle function in knee OA remains uncertain.

Objective: To examine the association between BMI and pressure biofeedback-assessed core muscle function in patients with knee osteoarthritis.

Methods: This pilot cross-sectional registry-based study included 15 adults with clinically and/or radiologically diagnosed knee OA selected by purposive sampling from the VIMS Knee Osteoarthritis Registry. BMI was calculated from recorded height and weight. Deep abdominal muscle function was assessed using a Pressure Biofeedback Unit (PBU) during an abdominal hollowing manoeuvre. Descriptive statistics were summarized as mean ± standard deviation or frequency (%). Because the data did not satisfy assumptions for parametric correlation, Spearman's rank correlation was used. Statistical significance was set at $p < 0.05$.

Results: The sample comprised 8 men (53.3%) and 7 women (46.7%), with a mean age of 64.87 ± 7.54 years. Mean BMI was 25.14 ± 4.29 kg/m² and the mean PBU reading was 34.0 ± 2.0 mmHg. Eight participants (53.3%) had a BMI in the normal range, six (40.0%) were overweight, and one (6.7%) was obese. BMI showed a very weak positive correlation with the PBU measure (Spearman's $\rho = 0.152$), which was not statistically significant ($p = 0.588$; approximate 95% CI, -0.39 to 0.62).

Conclusion: In this small pilot sample, BMI was not significantly associated with PBU-assessed deep abdominal muscle function. The wide confidence interval and restricted distribution of BMI, including only one participant with obesity, preclude a definitive conclusion regarding the absence of an association. Weight status and core motor control should therefore be assessed as related but distinct clinical domains in knee OA. Larger multicentre studies using comprehensive measures of trunk muscle performance are warranted.

Keywords: Body mass index; core stability; Knee osteoarthritis; Obesity; Pressure biofeedback unit; Transversus abdominis

Introduction

Osteoarthritis (OA) is a chronic whole-joint disorder characterized by progressive structural change, pain, stiffness, and loss of function. The knee is among the most frequently affected joints and knee OA is a major contributor to disability in middle-aged and older adults [1,2]. Population-based evidence indicates that age, excess body weight, female sex, and previous knee injury are among the factors associated with the onset and burden of knee OA [2,3].

Obesity is particularly important because it may influence knee OA through both mechanical and systemic pathways. Increased body mass raises joint loading during weight-bearing activities, while adipose tissue-derived inflammatory

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mediators may contribute to metabolic and inflammatory mechanisms relevant to joint degeneration [3,4]. These effects are clinically important because higher levels of obesity are associated with greater pain and functional limitation in people with knee OA.

Muscle function is another important component of knee OA rehabilitation. Although quadriceps impairment has received most attention, the trunk and lumbopelvic musculature contributes to postural control and the transfer of forces between the trunk and lower limbs. In adults with radiographic knee OA, reduced size and quality of the paraspinal musculature have been associated with the presence of disease, supporting a possible link between proximal muscle status and knee mechanics [5]. Intervention studies have also suggested that programmes incorporating core activation or stabilization can improve pain, gait, and patient-reported function in knee OA, although the evidence remains limited and heterogeneous [6-8].

Body mass and trunk muscle function may therefore represent two clinically relevant, but not necessarily parallel, features of knee OA. Despite the established association between excess weight and knee OA, comparatively little research has examined whether BMI itself is related to deep abdominal muscle performance in affected patients. The present registry-based pilot study was undertaken to assess BMI and pressure biofeedback-assessed core muscle function in patients with knee OA and to determine the correlation between these variables.

Materials and Method

Study design and data source

This was a pilot cross-sectional observational study based on data from the VIMS Knee Osteoarthritis Registry maintained by the Department of Musculoskeletal Physiotherapy, DVVPF's College of Physiotherapy, Ahilyanagar. The registry was developed to support standardized clinical documentation and research by recording demographic, anthropometric, clinical, and functional information in individuals with knee OA.

Participants

Fifteen adults with knee osteoarthritis were included by purposive sampling. Eligible participants were men or women aged 40-80 years with a diagnosis of knee OA based on clinical and/or radiological findings. Exclusion criteria were recent trauma or surgery involving the lower extremity or spine, neurological disorders affecting trunk or lower-limb function, pregnancy, and severe musculoskeletal deformity.

Outcome measures

Age and sex were obtained from the registry. BMI was calculated as body weight in kilograms divided by height in metres squared (kg/m²). For descriptive presentation, BMI was categorized using conventional adult cut-offs as normal weight (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), or obesity (≥30.0 kg/m²).

Core muscle function was assessed with a Pressure Biofeedback Unit during an abdominal hollowing manoeuvre, as recorded in the registry. A PBU provides an indirect measure of pressure change associated with recruitment of the deep abdominal musculature, particularly the transversus abdominis; it should not be interpreted as a direct dynamometric measure of muscle force [9]. Published work suggests that PBU measurements can have acceptable test-retest reproducibility under standardized conditions, although measurement properties vary across protocols and examiners [9,10]. Accordingly, the present manuscript reports the recorded PBU value in mmHg as an indicator of deep abdominal muscle function rather than as a direct measure of global trunk strength.

Statistical analysis

Data were summarized using frequency and percentage for categorical variables and mean ± standard deviation for continuous variables. Because the variables did not meet assumptions for parametric correlation, the association between BMI and the PBU measure was assessed using Spearman's rank correlation coefficient (ρ). An approximate 95% confidence interval for the correlation was derived using Fisher's z transformation. Statistical significance was defined as a

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two-sided p value <0.05. Given the pilot sample size, the analysis was considered exploratory and emphasis was placed on the magnitude and uncertainty of the observed association.

Results

A total of 15 participants with knee osteoarthritis were included. Eight participants (53.3%) were men and seven (46.7%) were women. The mean age was 64.87 ± 7.54 years. BMI ranged from 18.59 to 36.98 kg/m²; eight participants (53.3%) were in the normal BMI category, six (40.0%) were overweight, and one (6.7%) had obesity (Table 1).

Table 1. Participant characteristics

Variable	Category	n (%)
Sex	Male	8 (53.3)
Sex	Female	7 (46.7)
BMI category	Normal weight	8 (53.3)
BMI category	Overweight	6 (40.0)
BMI category	Obesity	1 (6.7)

The mean BMI was 25.14 ± 4.29 kg/m², while the mean PBU reading was 34.0 ± 2.0 mmHg (Table 2). The average BMI therefore fell just within the overweight range; however, the distribution was heterogeneous and most participants were either normal weight or overweight rather than obese.

Table 2. Descriptive statistics for continuous variables

Variable	Mean ± SD
Age (years)	64.87 ± 7.54
BMI (kg/m²)	25.14 ± 4.29
PBU reading (mmHg)	34.0 ± 2.0

Spearman's rank correlation showed a very weak positive relationship between BMI and the PBU measure (ρ = 0.152). This correlation was not statistically significant (p = 0.588), and the approximate 95% confidence interval was wide and crossed zero (-0.39 to 0.62) (Table 3). The data therefore do not provide evidence of a statistically detectable association between BMI and PBU-assessed deep abdominal muscle function in this sample.

Table 3. Correlation between BMI and PBU-assessed core muscle function

Comparison	Spearman ρ	p value	Approx. 95% CI
BMI vs PBU reading	0.152	0.588	-0.39 to 0.62

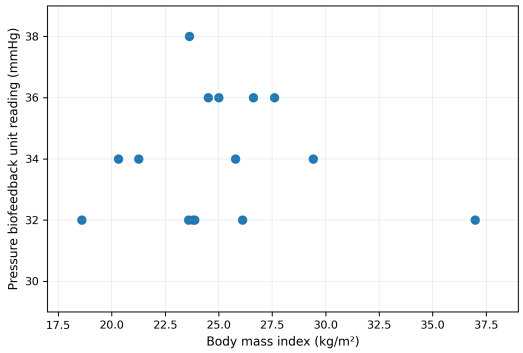


Figure 1. *Scatter plot of body mass index and PBU reading in the 15 participants. Spearman's ρ = 0.152; p = 0.588.*

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Discussion

This pilot registry-based study examined whether BMI was associated with deep abdominal muscle function, assessed using a pressure biofeedback measure, in patients with knee osteoarthritis. The observed correlation was very small (ρ = 0.152) and not statistically significant. Importantly, the confidence interval was wide and compatible with both a moderate inverse and a moderate positive association. The findings should therefore be interpreted as inconclusive rather than as evidence that BMI has no relationship with core muscle function.

The absence of a detectable association is plausible for several reasons. BMI is a measure of body mass relative to height and does not directly quantify muscle quality, neuromuscular control, trunk endurance, or the ability to selectively recruit the transversus abdominis. In addition, only one participant in this sample met criteria for obesity. This restricted representation of higher BMI values reduces the ability to examine whether more marked adiposity is associated with altered deep abdominal muscle performance. By contrast, previous studies linking obesity with knee OA have primarily demonstrated relationships with disease risk, pain, structural severity, and functional limitation rather than with a specific measure of trunk muscle recruitment [3,4,11].

The core musculature nevertheless remains relevant to knee OA rehabilitation. Azuma et al. reported that smaller and poorer-quality paraspinal muscles were associated with radiographic knee OA [5]. Clinical intervention studies have also reported improvement in pain, function, gait speed, or knee loading after programmes that included core activation or stabilization exercises [6-8]. These studies address the therapeutic role of proximal muscle training rather than the relationship between BMI and core function, and therefore do not conflict with the present finding of a weak cross-sectional correlation.

The measurement method is also important. Pressure biofeedback is a practical clinical tool, but it reflects pressure change associated with selective deep abdominal recruitment rather than direct force production by the entire trunk musculature [9,10]. A participant may therefore demonstrate an adequate PBU response despite limited trunk endurance or weakness in other muscle groups. Conversely, pain, fear of movement, physical inactivity, disease severity, or impaired motor control could influence the PBU response independently of BMI.

From a clinical perspective, BMI and core muscle function should not be treated as interchangeable markers. Contemporary OA guidelines strongly support exercise for knee OA and recommend weight loss for patients who are overweight or obese [12]. The present findings support assessing these domains separately: weight management should be considered on its own indications, while trunk and lower-limb muscle performance should be evaluated directly and addressed according to the patient's functional deficits.

Limitations

The sample was very small (n = 15), limiting statistical power and precision. The single-centre purposive sample may not represent the wider knee OA population. The cross-sectional design cannot establish temporal or causal relationships. BMI distribution was narrow, with only one participant in the obesity category, reducing the ability to investigate effects at higher levels of adiposity. The PBU provides an indirect measure of deep abdominal muscle recruitment rather than a comprehensive assessment of trunk strength or endurance. Potentially important covariates, including radiographic disease severity, pain intensity, symptom duration, physical activity, fear of movement, and comorbidity burden, were not incorporated into the analysis.

Clinical implications

Physiotherapists should assess body weight status and core muscle function as distinct components of a comprehensive knee OA evaluation. A normal BMI should not be assumed to indicate adequate trunk motor control, and a higher BMI should not be assumed to imply core muscle dysfunction. Where clinically appropriate, rehabilitation can combine evidence-based knee and lower-limb exercise with targeted trunk stabilization and individualized weight-management strategies, while monitoring pain, function, and movement quality.

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Conclusions

In this registry-based pilot sample of 15 patients with knee osteoarthritis, BMI showed a very weak, statistically non-significant correlation with PBU-assessed deep abdominal muscle function. Because the estimate was imprecise and the sample included few participants with obesity, the study cannot exclude a clinically relevant association. Larger, adequately powered multicentre studies using comprehensive measures of trunk strength, endurance, and neuromuscular control are required to clarify whether body composition and core muscle function are related in knee OA.

Declarations

Conflict of interest: The authors declare no conflict of interest.

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