

[ORIGINAL ARTICLE]**Association Between BMI and Quadricep Strength on Function, Health Related Quality of Life and Progression of Condition in A Patient with Osteoarthritis of Knee Joint: A Cross-Sectional Study****Thakkar Kruti**

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ABSTRACT

Background: Knee OA is a leading cause of pain, disability, and reduced QoL globally, especially in aging. BMI is a critical risk factor for OA. Quadriceps strength plays a crucial role in joint stability and function, with weaker quadriceps associated with poorer outcomes in OA patients.

Methods: A total of 200 patients with knee OA were recruited. BMI recorded physical examinations, Quadriceps strength measured using handheld dynamometer, and OA severity using the KL grading system. Functional ability through the WOMAC, and HRQoL using SF-36 questionnaire.

Results: Higher BMI was significantly correlated with worse knee function, poorer HRQoL, and advanced OA progression. Quadriceps strength showed significant positive correlations with knee function and slower OA progression, but no significant correlation with HRQoL.

Conclusions: The findings suggest that high BMI negatively impacts function, quality of life, and disease progression in knee OA patients, while stronger quadriceps are associated with better function and slower OA progression.

Keywords: *Osteoarthritis, BMI, Quadricep Strength, WOMAC, HRQoL*

Introduction

Knee osteoarthritis (OA) is a leading cause of pain, disability, and reduced quality of life globally, especially in aging populations^[1]. One of the most critical risk factors for knee OA is body mass index (BMI), as excess weight increases the mechanical load on the knee joint, accelerating cartilage wear and OA progression^[2]. This added joint stress can lead to more rapid joint space narrowing and osteophyte formation, hallmarks of disease progression^[3].

Quadriceps strength plays a vital role in knee stability and function, and weak quadriceps are associated with poorer outcomes in OA patients^[4]. Strengthening the quadriceps has been shown to improve joint stability and functional mobility, potentially slowing progression^[5]. Therefore,

understanding the combined effects of BMI and quadriceps strength on knee OA progression is crucial for developing effective management strategies^[6].

Low quadriceps strength in patients with high BMI may exacerbate the impact of excess weight on the knee, leading to worsened function and more rapid disease progression^[7]. Studies suggest that addressing muscle strength deficits in OA patients is essential, as stronger quadriceps have been associated with better knee function and slower cartilage degeneration^[8].

Additionally, health-related quality of life (HRQoL) is significantly impaired in patients with knee OA due to chronic pain, reduced mobility, and functional limitations^[9]. Stronger quadriceps have been linked to improved HRQoL in OA patients, as they

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contribute to better physical function and reduced pain levels^[10]. By analyzing the relationship between BMI, quadriceps strength, and HRQoL, this study will provide important insights for clinicians in developing targeted interventions to enhance patient outcomes^[11].

The progression of knee OA can also be influenced by modifiable factors such as BMI and muscle strength^[12]. Weight management and strength training are often recommended as first-line interventions in conservative OA management^[13]. Weight reduction can reduce mechanical loading on the knee joint, while muscle strengthening improves joint stabilization, creating a synergistic effect in reducing OA symptoms and progression^[14].

Increased BMI not only adds mechanical stress to the knee but also contributes to a pro-inflammatory state, which further accelerates joint degradation^[16]. This study's focus on BMI and quadriceps strength will provide evidence on how addressing both these factors can improve patient outcomes by mitigating joint degeneration and enhancing function^[16].

Rehabilitation programs that target both quadriceps strengthening and weight management may significantly impact functional outcomes and quality of life in knee OA patients^[17]. Research shows that exercise programs tailored to strengthen the quadriceps can improve mobility, reduce pain, and delay the progression of OA, while also contributing to weight loss^[18].

This study fills a gap in the current literature by analyzing the combined effects of BMI and quadriceps strength on the functional and clinical outcomes in knee OA patients^[19]. The findings will guide clinicians in designing personalized rehabilitation programs, aiming to slow OA progression and improve quality of life^[20].

Study Significance

Knee osteoarthritis is a leading cause of disability, especially in older adults. Higher BMI is often linked to worse outcomes in knee OA, affecting both joint function and overall quality of life. This study aims to investigate the relationship between BMI and these outcomes to better understand its impact on patients' daily lives and inform management strategies.

Study Objectives

- To assess the relationship between BMI and functional ability in patients with knee osteoarthritis.

- To evaluate the association between BMI on Quality of Life (QoL) and Progression of condition in patients with knee osteoarthritis.
- To assess the relationship between Quadricep Strength and functional ability in patients with knee osteoarthritis.
- To evaluate the association between Quadricep Strength on Quality of Life (QoL) and Progression of condition in patients with knee osteoarthritis.

Methodology

It was patients based cross sectional study. The Purposive sampling method was used to conduct the study; about 200 patients were taken into the study and during the study duration of 1 year. The present study was conducted among the patients diagnosed with knee osteoarthritis was recruited from different hospitals and OPDs. Written informed consent was taken from all the patients. We included both male and female with age between 50-75 years who were radiographically confirmed knee OA with Kellgren-Lawrence grades 1-4 and the patients who were willing to take part in the study. We excluded Patients with recent knee surgery or injury with other significant comorbidities like RA or Neurological disorders from the study. In Outcome Measure: Body Mass Index was measured during a physical examination, in which the height (m) was measured by the stadiometer and weight (kg) by the weighing scale. Quadriceps Strength Measurement: Quadriceps strength was assessed using hand held dynamometer (ICC 0.60 - 0.66)^[21]. Peak torque values were recorded for both knees, with higher values representing greater strength which measured in high sitting position and isometric assessment was used, Radiographic Evaluation: The severity of knee OA was determined using standard weight-bearing knee radiographs. The Kellgren-Lawrence grading system was used to classify the progression of OA based on the extent of joint space narrowing, osteophyte formation and other degenerative changes (ICC 0.10–0.83)^[22]. KL Grading was done by the radiologist. Functional Assessment: Functional mobility and pain were evaluated using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) (ICC 0.9860)^[23], which measure pain, stiffness, and physical function., Quality of Life: QoL will be assessed using SF-36 questionnaires (ICC 0.75-0.85)^[24].



Fig. 1: Quadriceps strength assessment by using Hand held Dynamometer

Table 1: Descriptive characteristics of patients with OA

| Characteristics | Mean±SD or n (%) |
|----------------------------------|---------------------------------------|
| Age (Years) | 60.13±7.35 |
| Gender | Male: 78 (52%), Female: 72 (48%) |
| BMI (kg/m ²) | 26.68±5.40 |
| BMI Category | Normal: 45, Overweight: 69, Obese: 36 |
| Quadriceps Strength (Nm/kg) | 30.54±14.40 |
| WOMAC Pain Score | 44.89±21.09 |
| Kellgren-Lawrence Grade 3 or 4 | 50 (33.33%) |
| HRQoL (SF-36 Physical Component) | 63.08±28.21 |
| Comorbidities | 78 (52%) |

Table 2: Correlation of BMI with Function, HRQoL and Progression of Condition OA

| VARIABLES | | r | p-value |
|-----------|--|--------|---------|
| BMI | Function (WOMAC) | 0.34** | 0.01 |
| | Quality of Life (SF-36) | 0.89* | 0.05 |
| | Progression (Kellgren-Lawrence (KL) Grading Scale) | 0.44* | 0.02 |

*Correlation is significant at the 0.05 level (2 -tailed)
 **Correlation is significant at the 0.01 level (2 -tailed)



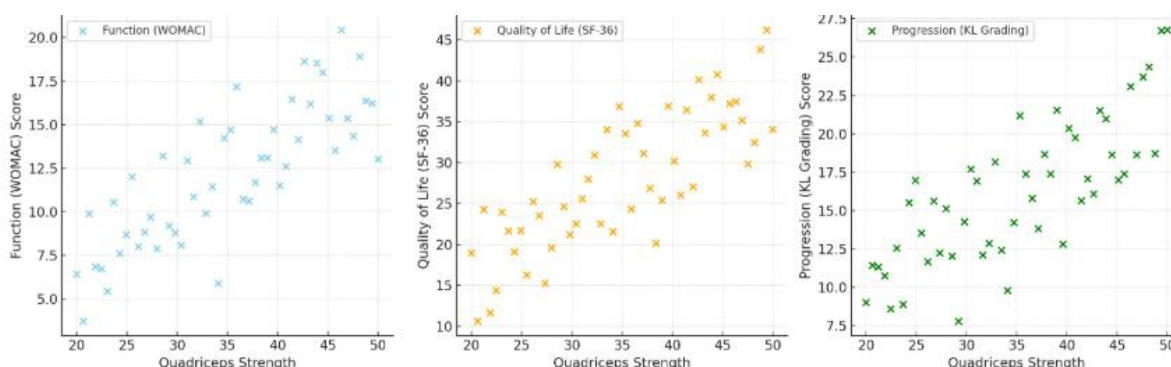
Graph 1: Scattered plot showing correlation of BMI with WOMAC, SF-36 and KL Grading

Table 3: Correlation of Quadricep Strength with Function, HRQoL and Progression of Condition in OA

| VARIABLES | | r | p-value |
|--------------------|--|-------|---------|
| Quadricep Strength | Function (WOMAC) | 0.35* | 0.02 |
| | Quality of Life (SF-36) | 0.81 | 0.56 |
| | Progression (Kellgren-Lawrence (KL) Grading) | 0.46* | 0.03 |

*Correlation is significant at the 0.05 level (2 -tailed)

**Correlation is significant at the 0.01 level (2 -tailed)



Graph 2: Scattered plot showing correlation of Quadricep Strength with WOMAC, SF-36 and KL Grading

Discussion

BMI is widely recognized as a significant risk factor for knee OA, with higher BMI contributing to both the onset and progression of the condition. Excess weight increases the mechanical load on the knee joint during activities such as walking, climbing stairs, and standing, which accelerates joint degeneration. This study confirms that patients with higher BMI exhibit worse functional outcomes and a faster progression of OA^[25]. Obesity not only exacerbates joint wear but also promotes chronic inflammation, a contributing factor to cartilage degradation. Hence, managing BMI is crucial in slowing down the progression of OA^[2].

Quadriceps strength plays a critical role in stabilizing the knee joint, controlling movement, and reducing load on the joint. Weakness in the quadriceps is a common finding in patients with knee OA and contributes significantly to impaired function. The results of this study highlight that patients with stronger quadriceps tend to have better knee function and less disability. This is consistent with previous research, which suggests that muscle strength can compensate for joint degeneration to some extent, allowing patients to maintain mobility and reduce the risk of further joint damage^[26].

However, the study also shows a negative association between BMI and quadriceps strength. Patients with higher BMI tend to have weaker

quadriceps, potentially due to reduced physical activity and higher levels of systemic inflammation. This is concerning because quadriceps strength is crucial for joint protection, and weaker muscles lead to poorer outcomes in terms of pain and functional limitations. Targeted interventions aimed at increasing muscle strength, especially in overweight and obese individuals, could therefore be beneficial in improving function and delaying the progression of OA^[27].

Function and health-related quality of life are major concerns for individuals with knee OA. The current study demonstrates that both high BMI and low quadriceps strength are associated with worse outcomes in these domains. Patients with higher BMI report greater difficulties in performing daily activities, which could be attributed to both the increased mechanical load on the knee joint and the reduced ability to engage in physical activity due to pain and discomfort^[28]. Additionally, lower quadriceps strength further impairs mobility, leading to greater dependence on others and reduced independence^[29].

Conclusion

The association between BMI and quadriceps strength plays a critical role in determining knee function, health-related quality of life, and the progression of knee OA. High BMI and poor quadriceps strength are linked to worse functional

outcomes and poor quality of life. High BMI results in increased score in Kellgren-Lawrence grading for the progression of the OA of the knee joint. These findings suggest that interventions focused on weight management and strengthening exercises could significantly improve the quality of life and slow the progression of OA in patients with knee joint osteoarthritis.

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Conflict of Interest

No Conflict of interest

Ethics approval

Ethical approval for this study was obtained Institutional Review Board

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