European Journal of Clinical Pharmacy

Print ISSN: 2385-409X **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Original Research Article

Association between Body Mass Index and Outcomes Following Total Knee Arthroplasty: A Prospective Cohort Study

Article History:

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Received: 16-11-2025
Revised: 21-12-2025
Accepted: 25-12-2025
Published: 30-12-2025

Abstract:
Objective: The impact of body mass index on postoperative outcome following total knee arthroplasty remains a subject of ongoing debate, with studies reporting inconsistent findings regarding functional recovery and pain. The incidence of obesity is on the rise in Pakistan and may prove to be detrimental for post-operative results, but local information about this problem is not available. ***Study Design:*** Prospective cohort study. ***Place and Duration of Study:*** Department of Orthopaedics Rehman Medical Institute Peshawar from 15th May 2025 to 15th November 2025. ***Methodology:*** This study included 344 patients who underwent primary unilateral TKA and were allocated into two groups based on BMI: Group A (obese, BMI > 30 kg/m^2; n = 170) and Group B (normal BMI, BMI < 25 kg/m^2; n = 174). Functional outcome was assessed using the WOMAC score at six months postoperatively and postoperative pain was measured using the Visual Analogue Scale at three months. ***Results:*** Among 344 patients (mean age 61.7 ± 6.6 years) obese patients demonstrated significantly worse functional outcomes with a median WOMAC score of 42.00 (IQR: 37.00–47.00) compared to 16.50 (IQR: 14.00–20.00) in the normal BMI group ($p < 0.001$). Postoperative pain was also significantly higher in the obese group with a median VAS score of 4.00 (IQR: 3.00–4.00) versus 1.00 (IQR: 1.00–2.00) in Group B ($p < 0.001$). Across all subgroups including age, gender, diabetes, and hypertension obese patients consistently reported higher WOMAC and pain scores with diabetic obese patients showing the worst outcomes in both measures. ***Conclusion:*** This study demonstrated that obesity was significantly associated with poorer functional outcomes and higher postoperative pain following TKA compared to patients with normal BMI. The presence of comorbidities such as diabetes and hypertension in obese patient further worsened postoperative recovery.

Keywords: Body Mass Index (BMI), Total Knee Arthroplasty (TKA), Postoperative Outcomes, Functional Recovery, Prospective Cohort Study

INTRODUCTION

Total knee arthroplasty (TKA) is considered an established method for management of end-stage knee osteoarthritis [1]. The main objectives of TKA surgery are pain management, deformity correction, and functional recovery. There has been a significant increase in the worldwide incidence of TKA in line with an aging population and increased prevalence of degenerative joint diseases [2]. Though total knee arthroplasty is highly successful and associated with high patient satisfaction rates, functional recovery after TKA varies from one individual to another [3]. Various parameters have an impact on post-TKA functional recovery, including patient- and surgery-related characteristics such as patient age, pre-existing conditions, baseline functional status, and

postoperative rehabilitation compliance [4].

BMI has become an important determinant in influencing patient outcomes after undergoing total knee arthroplasty. Obesity can increase the occurrence and severity of knee osteoarthritis, which is attributed to increased mechanical loading and chronic low-grade inflammation [5]. Several research papers have reported an association of BMI with prolonged operative time and higher risk of perioperative complications and implant-related issues [6]. However, the impact of BMI on functional recovery following TKA remains inconclusive. While some studies report that obese patients achieve comparable outcomes in terms of pain relief and functional improvement, other studies demonstrate inferior functional outcomes and delayed rehabilitation [7,8].

Postoperative pain is one of the most significant factors determining the recovery process after total knee arthroplasty as inadequate pain management can impair mobility, prolong hospital stay and limit participation in rehabilitations [9]. The intensity and duration of postoperative pain may vary between individuals due to multiple contributing factors, including surgical technique and patient-specific characteristics such as body mass index [10]. It has been suggested that higher body mass index may be associated with increased postoperative pain; however, the findings remain inconsistent across studies [11].

Total knee arthroplasty is one of the most commonly done orthopaedic procedure for relieving pain and improving mobility in patient with advanced knee osteoarthritis. Obesity has become increasingly common in Pakistan and is considered an important factor that may affect postoperative recovery, functional outcome, wound healing and risk of complications after surgery. However local data regarding the association between body mass index and outcome following total knee arthroplasty is limited particularly in Peshawar where lifestyle, nutritional status and patient characteristics may differ from other population. Therefore, this study will help to identify the impact of body mass index on surgical outcome and may assist surgeon in preoperative counselling, risk stratification and improving postoperative management of patient undergoing total knee arthroplasty in our local population.

METHODOLOGY

Study design and populations

This prospective cohort study was conducted at the Department of Orthopaedics Rehman Medical Institute Peshawar from 15th May 2025 to 15th November 2025. All patient aged 40-80 years of either gender who underwent primary unilateral total knee arthroplasty during the study period were eligible for inclusion. Patient having body mass index (BMI) >30 Kg/m² were included in obesity group (Group A), while patients having BMI <25 Kg/m² were included in normal BMI group (Group B). BMI was calculated by dividing weight in kilograms by square of height in metres using the formula BMI = Weight (kg)/Height² (m²). Patient with history of previous knee replacement surgery in the same joint, advanced osteoporosis, neurological disorders including Parkinson's disease or stroke, severe cardiovascular disease, active infection or systemic inflammatory disease were excluded from the study.

Sample size of 344 patient was calculated by using OpenEPI sample size calculator with 5% level of significance and 80% power, using mean postoperative pain score of 0.90 ± 0.70 in patients with normal BMI compared with 1.11 ± 0.69 in patients with obesity following total knee arthroplasty. The calculated sample size was 172 patients for each group; however, final analysed participants included 170 patient in obesity group and 174 patient in normal BMI group due to exclusion of a small number of patients from obesity group because of incomplete follow-up data and inclusion of additional eligible participants from normal BMI group during consecutive sampling.

Eligible patients were identified from Orthopaedic Department and informed written consent was obtained before inclusion in the study. Baseline clinical history and demographic details were confirmed before surgery. The study was approved by the institutional ethical committee (Ref: RMI-REC/Ethical Approval/Student Synopsis (Revised Version)/74, dated April 8, 2025).

Data collection

Collected data included age, gender, BMI, residence, diabetes, hypertension and clinical examination finding. All patients underwent total knee arthroplasty according to standard surgical protocol. Patients were placed in supine position with knee flexed at 90 degrees. Following sterile preparation and draping, prophylactic antibiotics were administered and a tourniquet was applied over upper thigh. A midline anterior incision was made followed by medial parapatellar arthrotomy for exposure of knee joint.

Bone preparation included removal of osteophytes, excision of menisci and anterior cruciate ligament, followed by proximal tibial and distal femoral cuts. Appropriate femoral and tibial components were selected after sizing and balancing of soft tissues. Trial components were inserted for assessment of alignment, stability and range of motion before final implantation. Final prosthesis implantation was completed after irrigation and cement preparation. Wound closure was performed in layers and sterile dressing was applied.

Postoperatively, intravenous analgesics were administered for first 48 hours followed by oral analgesics. Deep vein thrombosis prophylaxis was given with rivaroxaban 10 mg daily for 2 weeks. Early mobilisation and physiotherapy were initiated within first 24 hours after surgery. Functional assessment was performed at 6 weeks, 3 months and 6 months after surgery. Pain assessment was carried out during hospital stay and at follow-up visits after discharge.

Functional outcome was assessed by WOMAC score after 6 months of surgery. WOMAC score ranged from 0 to 96 and was used for evaluation of pain, stiffness and physical function. Postoperative pain score was assessed using Visual Analogue Scale (VAS) after 3 months of surgery where score ranged from 0 to 10.

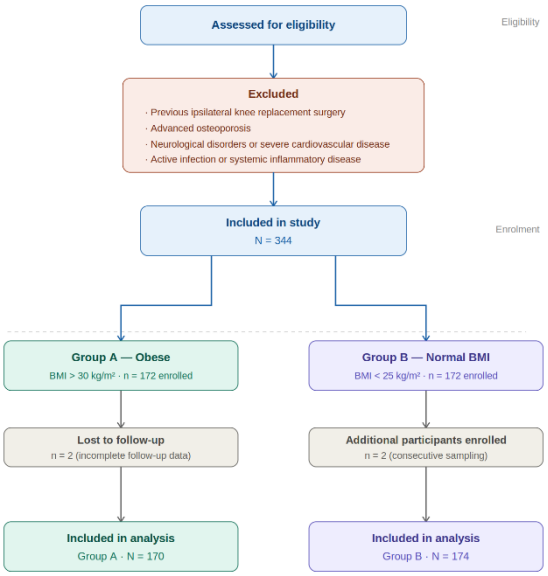
Statistical analysis

Data were analysed using SPSS version 26. Quantitative variables were assessed for normality by using Shapiro-Wilk test. As WOMAC score and postoperative pain score were not normally distributed (p-value <0.05) these variables were presented as median and interquartile range (IQR). Categorical variables were presented as frequencies and percentages. Mann-Whitney U test was applied to compare WOMAC score and postoperative pain score between the obesity group and normal BMI group. Stratification was performed for age, gender, diabetes and hypertension. Post-stratification analysis was also carried out using Mann-Whitney U test. A p-value <0.05 was considered statistically significant. Relative risk and 95% confidence intervals were calculated where appropriate.

RESULTS

Study population and patient characteristics

Figure 1 illustrates the participant selection process for the study. A total of 344 patients were assessed for eligibility at the Department of Orthopaedics, Rehman Medical Institute Peshawar. The final study cohort comprised 344 eligible participants, who were allocated into two groups based on body mass index: Group A (obese, BMI > 30 kg/m²; n = 172 enrolled) and Group B (normal BMI, BMI < 25 kg/m²; n = 172 enrolled). Two patients in Group A were lost to follow-up due to incomplete data and were excluded from the final analysis, while two additional eligible participants were enrolled into Group B through consecutive sampling. Consequently, 170 patients were included in the final analysis in Group A and 174 in Group B, yielding a total analysed cohort of 344 participants.



The study comprised a total of 344 patients which was divided into two groups: obese group (n=170) and non-obese group (n=174). The mean age of obese patients was 63.14 ± 6.46 years whilst non-obese patients had a mean age of 60.22 ± 6.66 years. The mean BMI in obese group was 35.04 ± 2.77 kg/m² as compared to 23.12 ± 1.80 kg/m² in non-obese group. Regarding gender distribution, majority of obese patients was female 112 (65.9%) and male patients was 58 (34.1%), whilst in non-obese group there was 74 (42.5%) male and 100 (57.5%) female patients. In terms of residential status, 98 (57.6%) obese patients was from urban areas and 72 (42.4%) was from rural areas, whereas in non-obese group 89 (51.1%) was urban and 85 (48.9%) was rural residents. Diabetes was present in 83 (48.8%) of obese patients and only 30 (17.2%) of non-obese patients, and hypertension was found in 102 (60.0%) of obese

patients as compared to only 25 (14.4%) of non-obese patients (Table 1).

Table 1. Patient Demographics in Both Groups

Variables	Obese Group (n=170)	Non-Obese Group (n=174)
	Mean ± SD	Mean ± SD
Age (years)	63.14 ± 6.46	60.22 ± 6.66
BMI (kg/m²)	35.04 ± 2.77	23.12 ± 1.80
Gender	n (%)	n (%)
Male	58 (34.1%)	74 (42.5%)
Female	112 (65.9%)	100 (57.5%)
Residential Status		
Rural	72 (42.4%)	85 (48.9%)
Urban	98 (57.6%)	89 (51.1%)
Diabetes		
Yes	83 (48.8%)	30 (17.2%)
No	87 (51.2%)	144 (82.8%)
Hypertension		
Yes	102 (60.0%)	25 (14.4%)
No	68 (40.0%)	149 (85.6%)

The comparison of outcome scores between both groups was showed statistically significant differences. The median WOMAC score in obese group was 42.00 (IQR: 37.00–47.00) which was considerably higher than non-obese group where median was 16.50 (IQR: 14.00–20.00), with p-value of less than 0.001. Similarly, the postoperative pain score was also significantly higher in obese patients with median of 4.00 (IQR: 3.00–4.00) as compared to non-obese patients who had median score of 1.00 (IQR: 1.00–2.00), and this difference was also statistically significant ($p<0.001$) (Table 2).

Table 2. Comparison of Outcome Scores Between Obese and Non-Obese Groups

Variables	Obese Group (n=170)	Non-Obese Group (n=174)	P-value
WOMAC Score	Median (IQR)	Median (IQR)	<0.001*
	42.00 (37.00 – 47.00)	16.50 (14.00 – 20.00)	
Postoperative Pain Score	Median (IQR)	Median (IQR)	<0.001*
	4.00 (3.00 – 4.00)	1.00 (1.00 – 2.00)	

Mann-Whitney U test; *Statistically significant ($p<0.05$

The stratified analysis of WOMAC score was revealed that obese patients consistently scored higher across all subgroups when compared to non-obese patients. Most notably, obese patients with diabetes had highest median WOMAC score of 45.00 (IQR: 40.50–49.00) compared to 18.50 (IQR: 16.00–23.00) in non-obese diabetic patients, and obese patients aged above 60 years also showed higher scores with median of 44.00 (IQR: 39.00–48.00) versus

18.00 (IQR: 16.00–22.00) in non-obese counterparts. All subgroup comparisons were statistically significant (p<0.001) (Table 3).

Table 3. Stratified Analysis of WOMAC Score Between Obese and Non-Obese Groups

Subgroup	Obese Group (Group A)	Non-Obese Group (Group B)	P-value
	Median (IQR)	Median (IQR)	
Age ≤ 60 years	40.00 (34.00 – 44.00)	15.00 (12.00 – 17.50)	<0.001*
Age > 60 years	44.00 (39.00 – 48.00)	18.00 (16.00 – 22.00)	<0.001*
Male	41.00 (35.00 – 47.00)	17.00 (15.00 – 20.00)	<0.001*
Female	43.00 (39.00 – 47.00)	16.00 (12.00 – 19.00)	<0.001*
Diabetes (Yes)	45.00 (40.50 – 49.00)	18.50 (16.00 – 23.00)	<0.001*
Diabetes (No)	40.00 (34.00 – 44.00)	16.00 (13.00 – 19.00)	<0.001*
Hypertension (Yes)	43.00 (38.00 – 47.00)	18.00 (16.00 – 20.00)	<0.001*
Hypertension (No)	41.00 (35.50 – 46.00)	16.00 (13.00 – 19.00)	<0.001*

Mann-Whitney U test; *Statistically significant (p<0.05)

For postoperative pain scores, obese patients with diabetes was showed highest median pain score of 4.00 (IQR: 4.00–5.00) in comparison to 2.00 (IQR: 1.00–2.00) in non-obese diabetic group, suggesting that presence of diabetes in obese patients was associated with worse pain outcomes. Across all other subgroups including age, gender, and hypertension status, obese patients were consistently reported higher pain scores than non-obese patients, and all differences was statistically significant (p<0.001) (Table 4).

Table 4. Stratified Analysis of Postoperative Pain Score Between Obese and Non-Obese Groups

Subgroup	Obese Group (Group A)	Non-Obese Group (Group B)	P-value
	Median (IQR)	Median (IQR)	
Age ≤ 60 years	4.00 (3.00 – 4.00)	1.00 (1.00 – 2.00)	<0.001*
Age > 60 years	4.00 (3.00 – 4.50)	2.00 (1.00 – 2.00)	<0.001*
Male	3.00 (3.00 – 4.00)	2.00 (1.00 – 2.00)	<0.001*
Female	4.00 (3.00 – 4.00)	1.00 (1.00 – 2.00)	<0.001*
Diabetes (Yes)	4.00 (4.00 – 5.00)	2.00 (1.00 – 2.00)	<0.001*
Diabetes (No)	3.00 (3.00 – 4.00)	1.00 (1.00 – 2.00)	<0.001*
Hypertension (Yes)	4.00 (3.00 – 4.00)	2.00 (1.00 – 2.00)	<0.001*
Hypertension (No)	4.00 (3.00 – 4.00)	1.00 (1.00 – 2.00)	<0.001*

Mann-Whitney U test; *Statistically significant (p<0.05)

DISCUSSION

The results of present study were showed that obesity was significantly associated with worse postoperative outcome in patients underwent total knee arthroplasty. The WOMAC score was found significantly higher in obese patients with median of 42.00 as compared to non-obese patients with median of 16.50, which suggest that obese patients had poorer functional outcomes after surgery. This findings can

be explained by the fact that excess body weight was putting more mechanical stress on knee joint, which was leading to increased inflammation and slower recovery of joint function after arthroplasty. Postoperative pain was also found considerably higher in obese group with median score of 4.00 as compared to 1.00 in non-obese group. This difference was likely due to the presence of chronic low-grade inflammations in adipose tissue of obese patients which was causing elevated levels of pro-inflammatory cytokines such as interleukin-6 and tumour necrosis factor-alpha and these mediators was contributing to increased pain perception after surgery. Diabetes was present in 83 (48.8%) of obese patient which was notably higher than 30 (17.2%) in non-obese group and diabetic obese patients was showed worst WOMAC and pain scores among all subgroups. This was scientifically explainable because diabetes was impairing microvascular circulation and peripheral nerve function which was further compromising tissue healing and was increasing postoperative pain sensitivity in these patients. Hypertension was also more prevalent in obese group with 102 (60.0%) patient as compared to only 25 (14.4%) in non-obese group. Obesity was known to activate renin-angiotensin-aldosterone system and was causing sympathetic nervous system overactivation which was leading to sustained elevated blood pressure and was also negatively affecting musculoskeletal recovery following knee arthroplasty.

The findings of present study were demonstrated that obese patients had significantly worse WOMAC scores with median of 42.00 as compared to 16.50 in non-obese patients, which was indicating poorer functional outcomes after total knee arthroplasty in obese individuals. These findings were in agreement with Sureen SK et al. [13] who also reported higher WOMAC scores and inferior functional outcomes in obese patients as compared to non-obese patients, and similarly Guo T et al. [14] also confirmed that increasing BMI was significantly associated with worse short-term postoperative knee function scores. The possible reason for this similarity was that excess adipose tissue in obese patients was producing higher levels of inflammatory mediators which was directly impairing joint recovery and functional rehabilitation after surgery. Polat G et al. [15] and Wang H et al. [16] further supported these results by reporting that higher BMI was negatively affecting postoperative functional outcomes and rehabilitation progress following arthroplasty procedures.

However, some studies were reporting contrasting findings. Reddy SN et al. [17] and Goutham B et al. [18] both reported no statistically significant difference in postoperative functional scores between normal weight and overweight or obese patients, and Khan MAS et al. [19] similarly concluded that obesity was not independently affecting postoperative outcomes after total knee arthroplasty. These contradictory results were possibly because these studies were using Knee Society Score and Forgotten Joint Score rather than WOMAC score, and their sample sizes was considerably smaller with only 50 and 100 patients respectively, which was limiting the statistical power to detect significant differences between groups. Oropeza-Bonfanti F et al. [20] also reported that although obese patients had worse baseline WOMAC scores, all BMI groups was achieving similar outcomes at one-year follow-up, which may suggesting that short-term differences in functional outcomes was diminishing over longer follow-up periods.

Postoperative pain was found significantly higher in obese group with median score of 4.00 as compared to 1.00 in non-obese group in present study. This was consistent with findings of Mishra AK et al. [21] who reported that pain score improvement was minimal in class III obese patients as compared to normal and overweight groups, and Giesinger K et al. [22] who noted that obese patients was having greater baseline pain burden before surgery. The scientific explanation for higher pain in obese patients was related to chronic activation of inflammatory pathways through adipokines and pro-inflammatory cytokines such as tumour necrosis factor-alpha and interleukin-6, which was sensitising peripheral pain receptors and was making postoperative pain management more difficult in these patients.

Diabetes was present in 83 (48.8%) of obese patients as compared to only 30 (17.2%) in non-obese group, and diabetic obese patients was showing worst functional and pain outcomes across all subgroups in present study. This was supported by Guo T et al. [14] who identified diabetes as an independent risk factor for poor postoperative knee function scores, and Correa-Valderrama A et al. [23] who reported that diabetes mellitus was significantly increasing infection risk after arthroplasty. The coexistence of obesity and diabetes was creating a compounding effect on surgical outcomes because diabetes was impairing microvascular circulation and wound healing whilst obesity was simultaneously increasing mechanical load and systemic inflammation, together worsening the overall postoperative recovery.

Hypertension was observed in 102 (60.0%) of obese patients compared to only 25 (14.4%) in non-obese patients, reflecting the well-established metabolic burden that was commonly accompanying obesity. Bhakar R et al. [24] similarly reported higher ASA scores and greater comorbidity burden in obese patients undergoing total knee arthroplasty, and Khan HD et al. [25] also highlighted the significant complication rates of 17.2% in morbidly obese patients, emphasising the importance of preoperative

optimisation of comorbidities including hypertension before performing arthroplasty in obese individuals. The presence of hypertension in obese patients was further compromising postoperative outcomes through its negative effects on peripheral tissue perfusion and musculoskeletal healing capacity.

Limitations

In terms of the limitation this study was carried out in one single centre, thus restricting the external validity of its findings. Also, crucial confounding factors like physical activity, eating habits, prior physiotherapy before operation, and design of the implant during the surgery were not considered or controlled, which might have had an impact on the results obtained from both the cohorts. Finally, being a prospective cohort study without any randomization, the chances of selection bias could not be completely ruled out despite trying to match the participants based on demographic factors.

CONCLUSION

This study found out that obesity had a significant association with poor functional outcomes and increased postoperative pain among the patients undergoing total knee arthroplasty surgery than non-obese individuals. In addition to this, it was observed that the complications like hypertension and diabetes among obese patients were aggravating their postoperative recovery, resulting in poor functional outcomes and increased pain levels.

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