Section: Orthopaedics

Original Research Article

FUNCTIONAL OUTCOME OF TOTAL KNEE REPLACEMENT IN OBESE PATIENTS: A PROSPECTIVE STUDY USING WOMAC SCORES WITH A 1-YEAR FOLLOW-UP

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ABSTRACT

Background: Objective: This prospective observational cohort study aimed to evaluate the functional outcomes of total knee replacement (TKR) in obese patients using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores preoperatively and at 1-year postoperatively.
Materials and Methods: Thirty-one obese patients (mean age 60.27 years, BMI 28.73 kg/m²) undergoing primary TKR for knee osteoarthritis were included. WOMAC scores (pain, stiffness, and physical function) were assessed preoperatively and at 12 months postoperatively. Statistical analysis included paired t-tests to compare pre- and postoperative scores.
Results: All patients demonstrated significant improvement in WOMAC scores post-TKR. The mean difference in WOMAC score was -39.4 points ($p < 0.001$), indicating substantial reduction in pain and improvement in physical function. Patient demographics showed a predominantly female (93.3%) cohort. Age and BMI did not significantly correlate with changes in WOMAC scores ($p > 0.05$).
Conclusion: TKR in obese patients resulted in significant functional improvement, as evidenced by reduced WOMAC scores at 1-year follow-up. These findings underscore the effectiveness of TKR in managing knee osteoarthritis in obese individuals.
Keywords: Total knee replacement, obesity, WOMAC score, osteoarthritis, functional outcome.

INTRODUCTION

Total knee replacement (TKR) is widely recognized as an effective intervention for patients with severe osteoarthritis (OA), particularly when conservative treatment options have been exhausted. However, the impact of obesity on TKR outcomes has been a subject of ongoing debate. Obesity, often quantified by body mass index (BMI), is linked to an increased risk of joint-related disorders due to both mechanical load and metabolic changes that exacerbate joint degeneration. The association of obesity with comorbidities like hypertension, diabetes, and inflammatory responses further complicates post-surgical recovery, as pro-inflammatory cytokines released by adipose tissue promote cartilage degradation, potentially intensifying the severity of OA. Given these risks, some clinicians have questioned the advisability of TKR in obese patients, as obesity may raise the likelihood of complications and impact the longevity of joint prostheses. Nonetheless, recent evidence suggests that TKR can still yield meaningful improvements in function and quality of life for obese patients, comparable to those seen in non-obese individuals.

Despite the documented benefits, there is variability in postoperative outcomes among obese patients undergoing TKR. Factors such as the degree of obesity, baseline health conditions, and adherence to rehabilitation may contribute to this heterogeneity.

Moreover, while some studies report that obese patients achieve less favorable outcomes than their non-obese counterparts, others indicate that they can attain comparable functional improvements. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a valuable tool in this context, as it provides a comprehensive assessment of pain, stiffness, and physical function in OA patients, thus enabling detailed tracking of functional outcomes post-TKR.

This prospective study evaluates the clinical outcomes of TKR in obese patients over a 1-year follow-up period, specifically analyzing WOMAC score changes to determine functional improvements. By examining WOMAC score trends pre- and post-surgery, the study seeks to clarify the extent to which TKR alleviates symptoms and enhances function in obese patients with knee OA, contributing to the broader understanding of the role of obesity in TKR outcomes.

Objective:

To assess the change in the functional outcome of obese patients undergoing total knee replacement (TKR) by evaluating their Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores preoperatively and at 1-year postoperatively.

MATERIALS AND METHODS

Study Design: A prospective observational cohort study at a tertiary care center.

Study Population:

Inclusion Criteria

- Obese patients scheduled for primary TKR due to knee osteoarthritis.
- Age 45–80 years.
- Patients willing to comply with a 1-year follow-up and provide informed consent.

Exclusion Criteria

- Non-obese patients
- Patients with previous knee surgeries.
- Patients with severe systemic diseases or inflammatory arthritis (e.g., rheumatoid arthritis).
- Patients unable to complete the follow-up period.

Sample Size: 31

Study Duration

- Follow-up Period: 12 months post-surgery.
- Final Data Collection: At the end of the 1-year follow-up period for all patients.

Outcome Measure

1. Primary Outcome

- Change in WOMAC score (pain, stiffness, and physical function) from baseline (preoperative) to 1-year post-TKR.

WOMAC consists of:

- Pain (5 items)
- Stiffness (2 items)
- Physical Function (17 items)

Scores will be recorded at

- Preoperative baseline (before surgery).
- 12 months post-TKR.

2. Secondary Outcomes

- Patient satisfaction.
- Improvement in mobility (assessed via clinical notes and patient-reported outcomes).

Methodology:

1. Recruitment and Consent

- Obese patients scheduled for TKR will be recruited from the orthopedics department.
- Informed consent will be obtained

2. Preoperative Assessment

- WOMAC scores collected at baseline (pre-TKR).
- Demographic data (age, gender, BMI).

3. Surgical Procedure

- All patients undergo a standardized TKR procedure by experienced surgeons.
- Same postoperative rehabilitation protocol for all patients.

4. Follow-up

- WOMAC score reassessed at 12 months postoperatively.
- Postoperative follow-up data (complications, clinical outcomes) will be gathered during routine clinical visits and documented.

5. Data Collection

- Data will be recorded electronically in a secure database.
- WOMAC scores will be collected at two time points: preoperative and 12 months post-TKR.

6. End of Study Data Collection

- At the conclusion of the study (1 year post-TKR for all patients), all WOMAC scores and clinical data will be consolidated for analysis.

Statistical Analysis

- Paired t-tests (or Wilcoxon signed-rank test) to evaluate changes in WOMAC scores between pre-TKR and 1-year post-TKR.
- Descriptive statistics to summarize baseline characteristics and outcomes.
- Subgroup analysis may be conducted (if relevant) based on comorbidities, degrees of obesity (e.g., moderate, severe, morbid obesity), or other clinical factors.

Ethical Considerations

- Ethical approval from the Institutional Review Board (IRB).
- All participants will provide informed consent.

Limitations

- Potential for patient loss to follow-up.
- Single-center study limits generalizability.

Expected Outcome

- Significant improvement in WOMAC scores post-TKR, particularly in pain reduction and physical function enhancement.
- Obese patients may demonstrate notable functional gains, though complications or slower recovery may occur.

RESULTS

Table 1: Quantitative variables

Variable	Count	Mean	Median	SD	Min	Max	Q1	Q3	IQR
Age	30	60.27	60	6.98	48	77	58	62	4
BMI	30	28.73	29	1.68	25.5	32	27.35	30	2.65
Pre-op WOMAC	30	42.86	45.5	11.32	15	59	39.25	50	10.75
Post TKR WOMAC	30	3.47	3	0.73	3	5	3	4	1

Table 2: Categorical variables

Variable	Category	N	Percent
Sex	Male	2	6.7%
	Female	28	93.3%
Side	Left	17	56.7%
	Right	13	43.3%

Table 3: Difference in WOMAC

Variable	Count	Mean	Median	SD	Min	Max	Q1	Q3	IQR
Difference in WOMAC	30	-39.4	-41.5	11.08	-56	-12	-46	-36	10

Table 4: Coefficients

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-6.5907	17.0751	-0.386	0.7024
AGE	-0.5444	0.2815	-1.934	0.0633

Correlation Coefficient	-0.3433
R-squared	0.1178
p-value	0.0633

The slope of the regression line is -0.5444, indicating that for each additional year of age, the difference in WOMAC score decreases by approximately 0.54 points. The p-value for the age coefficient is 0.0633, which is slightly above the conventional significance level of 0.05, suggesting that the relationship is not statistically significant at the 5% level. The R-squared value is 0.1178, indicating that approximately 11.78% of the variability in the difference in WOMAC scores can be explained by age

Table 5: Coefficients

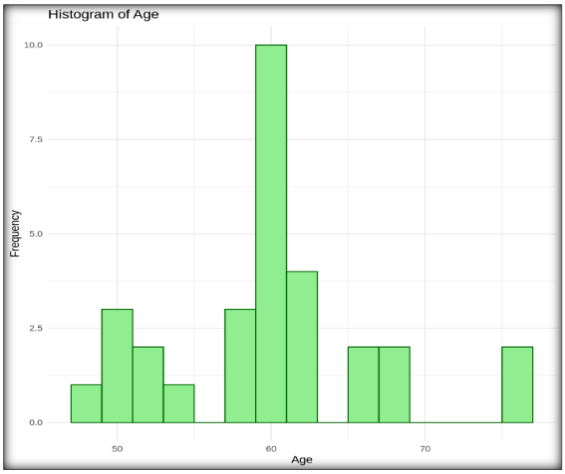
	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-14.4450	35.4357	-0.408	0.687
BMI	-0.8687	1.2315	-0.705	0.486

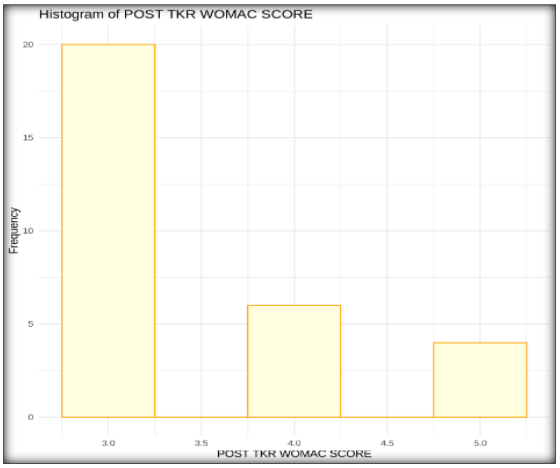
Correlation Coefficient	-0.1321
R-squared	0.0175
p-value	0.4864

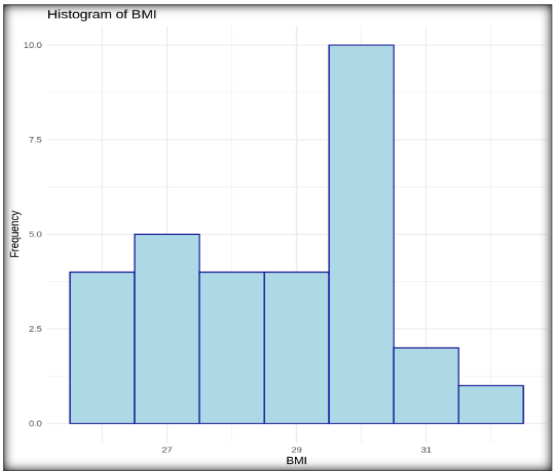
The regression analysis indicates that the relationship between BMI and the change in WOMAC scores is not statistically significant, with a p-value of 0.4864 and an R-squared value of 0.0175, suggesting that BMI explains only about 1.75% of the variability in the improvement of WOMAC scores post-surgery.

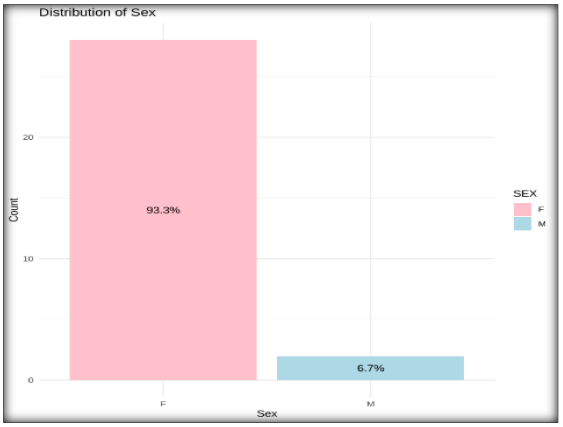
Paired t-test

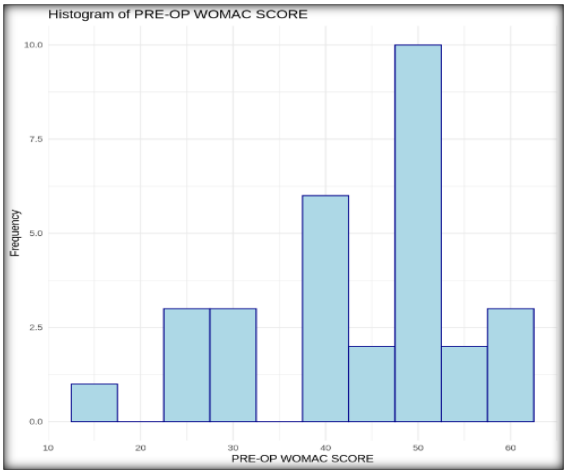
t	df	p-value	Mean diff.	95% Confidence Interval
19.474	29	<0.001	39.4	35.26209, 43.53791

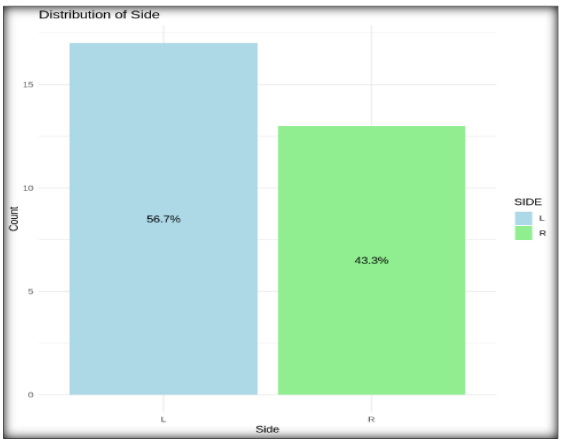

Histogram of Age
Frequency
Age

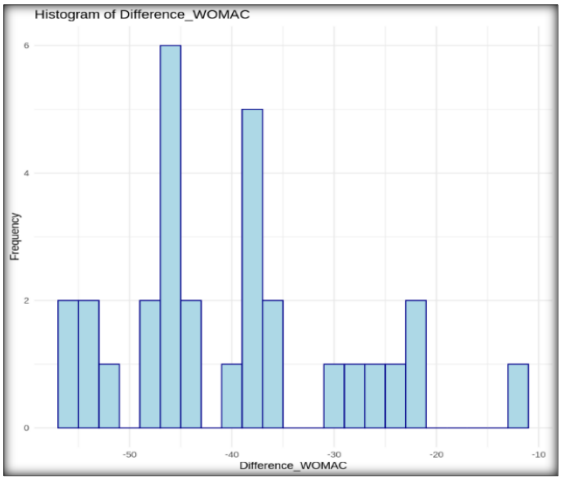

Histogram of POST TKR WOMAC SCORE
Frequency
POST TKR WOMAC SCORE


Histogram of BMI
Frequency
BMI


Distribution of Sex
Count
93.3%
6.7%
SEX
F
M
Sex


Histogram of PRE-OP WOMAC SCORE
Frequency
PRE-OP WOMAC SCORE

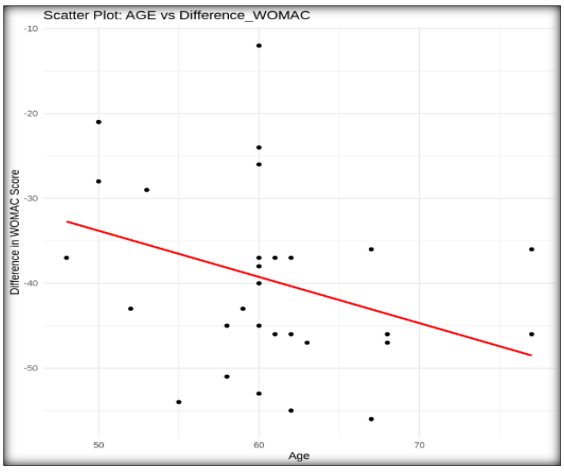

Distribution of Side
Count
56.7%
43.3%
SIDE
L
R
Side



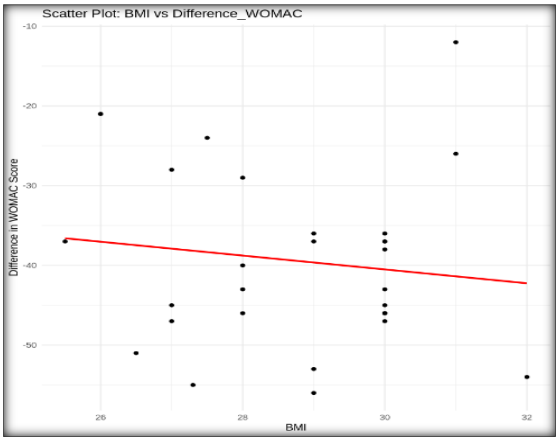
All Difference WOMAC values are negative, indicating that all patients had lower WOMAC scores after the TKR surgery compared to their pre-operative scores. The average decrease in WOMAC score is 39.4 points, with a median decrease of 41.5 points. This suggests a substantial improvement in patients' conditions after the surgery.

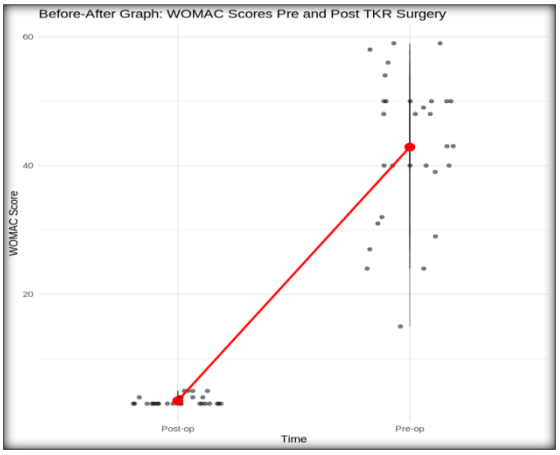
The range of improvement is from 12 points (minimum difference) to 56 points (maximum difference), indicating that all patients experienced some level of improvement, but the degree of improvement varied considerably. The distribution of "Difference_WOMAC" is fairly symmetric, as the mean and median are close to each other. The standard deviation of 11.08 indicates moderate variability in the degree of improvement among patients.

Correlation between age and difference in WOMAC score



Correlation between age and difference in WOMAC score





There is a clear and consistent decrease in WOMAC scores from pre-op to post-op for almost all patients. The spread of scores appears to be much smaller in the post-op condition compared to the pre-op condition. The mean score (red dot) shows a substantial decrease from pre-op to post-op.

DISCUSSION

Body mass index (BMI), derived from a person's height and weight, classifies individuals as overweight or obese and is used to evaluate the risk of chronic conditions like hypertension, diabetes, cancer, and hypercholesterolemia, while also serving as a predictor of long-term health outcomes starting from childhood.[1] It is a numerical value derived by dividing an individual's weight, measured in kilograms, by the square of their height in meters (kg/m^2). However, while BMI is a useful screening tool, it does not account for variations in muscle mass, fat distribution, or other factors that can influence overall health.[2] Obesity exerts both biochemical and biomechanical stress on the body, leading to damage in bones and surrounding soft tissues by disrupting normal metabolic processes and increasing the mechanical load on joints, which accelerates wear and tear, weakens the musculoskeletal structure, and contributes to the development of various joint-related disorders.[3] Recent research has explored how obesity-related

adipose tissue and altered lipid metabolism contribute to advanced arthritis, as pro-inflammatory cytokines like TNF-α and IL-6 are released from adipose tissue, promoting the upregulation of matrix metalloproteinases (MMPs) that degrade cartilage.[4] Research indicates that for every 5 kg/m² increase in body mass, the risk of developing knee OA rises by 35%.[5]

The available evidence on functional outcomes in obese patients following surgery presents mixed conclusions. Some studies suggest that obesity may lead to poorer postoperative results, with patients achieving less favorable outcomes in terms of function and recovery.[6] However, other research indicates that obese individuals can attain functional outcomes comparable to those of non-obese patients, highlighting ongoing debate in the field.[7] These differing conclusions underscore the need for further investigation to clarify how obesity impacts recovery and long-term results in procedures like total knee replacement. Patients with advanced, painful knee osteoarthritis who are obese are often deemed unsuitable candidates for total knee replacement (TKR).[8]

Total knee replacement in obese patients can be justified due to comparable functional improvements to those with lower BMI, though it carries a higher risk of complications, reduced prosthetic longevity, and a significant burden on the healthcare system.[9]

Morbid obesity has been linked to a higher risk of early postoperative complications, such as peripheral edema, gastrointestinal symptoms like diarrhea and abdominal discomfort, wound inflammation or infection, infections at nonsurgical sites, and respiratory or lung infections.[10] The WOMAC is a self-administered tool used to evaluate health status in patients with osteoarthritis (OA) of the hip or knee, assessing pain, stiffness, and physical function either individually or as a composite index, and is available in various formats, including a 5-point Likert scale, an 11-point numerical rating scale, and a 100-mm visual analogue scale (VAS); it comprises 24 questions in total—5 addressing pain during specific activities like walking on a flat surface, climbing stairs, at night while lying in bed, sitting or lying down, and standing upright, 2 questions related to stiffness, and 17 focusing on physical function.[11]

Total Knee Arthroplasty (TKA) in obese patients (BMI ≥ 30 kg/m²) is associated with higher rates of surgical and medical complications, including wound issues, infections, and increased care costs, yet paradoxically shows lower incidences of anemia, arrhythmia, cardiac arrest, and transfusions, with overall outcomes not definitively worse than non-obese patients, highlighting the need for further research into the underlying mechanisms and risk management strategies as obesity continues to rise globally.[12] The study by Baum et al showed that both preoperative and postoperative WOMAC scores were inferior among obese patients compared to non-obese patients,non-obesity and higher preoperative WOMAC scores were predictive of greater WOMAC change scores at two months and non-smoking was the only significant predictor of TKA satisfaction after two months.[13]

Papakostidou et al. carried out a comparable analysis study regarding WOMAC score changes 12 months post-surgery and their findings indicated that higher baseline function and pain scores on the WOMAC were predictive of greater improvements, whereas obesity status did not serve as a significant predictor.[14] In a prospective study examining the correlation between body mass index (BMI) and functional outcomes of total knee replacement for osteoarthritis in a South Indian cohort, it was found that BMI positively correlates with both preoperative and postoperative scores, suggesting that incorporating weight-loss programs into patient care could significantly enhance surgical outcomes and should be discussed as part of the treatment plan.[15]

The results of this prospective study demonstrate a significant improvement in the functional outcomes of obese patients undergoing total knee replacement (TKR), as measured by the WOMAC scores over a 1-year follow-up period. The consistent reduction in WOMAC scores across the cohort, with an average decrease of 39.4 points, highlights a substantial alleviation of pain, stiffness, and improvement in physical function post-surgery. The median reduction of 41.5 points further reinforces the significant improvement in patient-reported outcomes, suggesting that TKR is effective in mitigating the debilitating effects of knee osteoarthritis (OA) in obese patients. Despite the overall improvement, the range of WOMAC score reductions—from 12 to 56 points—indicates variability in patient outcomes. This variability could be attributed to individual factors such as pre-existing comorbidities, varying degrees of obesity, or differences in rehabilitation adherence, all of which may influence recovery trajectories. The standard deviation of 11.08 reflects moderate variability, suggesting that while the majority of patients experienced significant functional gains, the extent of improvement was not uniform across the cohort.

Age appears to have a marginal impact on the improvement of WOMAC scores, with the regression analysis indicating that for each additional year of age, the post-TKR WOMAC score decreases by 0.54 points, though this relationship did not reach statistical significance ($p = 0.0633$). This finding suggests that while older patients may experience slightly less improvement, the effect of age on functional outcomes is relatively minor. Similarly, BMI showed no statistically significant correlation with changes in WOMAC scores ($p = 0.4864$), with BMI accounting for only 1.75% of the variability in outcomes. These results imply that, within this obese population, factors such as age and BMI do not play a prominent role in determining post-surgical improvement in WOMAC scores.

Notably, the decrease in WOMAC scores was consistent across all patients, with a much narrower spread in post-operative scores compared to pre-

operative values. This suggests a more homogenous improvement in functional status following TKR, irrespective of baseline variability. The sharp reduction in mean WOMAC scores, pain, which aligns with existing literature highlighting the benefits of TKR in obese patients. However, the single-center design and potential for loss to follow-up are limitations that may restrict the generalizability of these findings.

CONCLUSION

The study reaffirms the effectiveness of TKR in improving the quality of life for obese patients with knee OA, with notable improvements in pain, stiffness, and function. Although age and BMI had limited influence on the outcomes, further studies with larger, more diverse populations could elucidate other factors contributing to variability in post-TKR recovery in obese individuals.

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