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Impact of Preoperative Body Mass Index on Functional Recovery After Total Knee Replacement Surgery

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Abstract

Background: Total knee replacement (TKR) is among the most frequently performed orthopaedic procedures worldwide, yet the influence of preoperative body mass index (BMI) on postoperative functional recovery remains a source of considerable clinical debate. Obese patients constitute a disproportionately large share of the TKR candidate pool, particularly in urban Iraqi tertiary-care settings where metabolic comorbidity burden is high.
Objective: To evaluate the association between preoperative BMI category and short-to-medium-term functional recovery, pain relief, and complication rates following primary TKR in a Al-Hilla General Teaching Hospital.
Methods: A retrospective cohort study was conducted on 248 patients who underwent primary unilateral TKR at a Al-Hilla General Teaching Hospital, between January 2019 and December 2022. Patients were stratified into four BMI categories: normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), obese class I (30.0–34.9 kg/m²), and obese class II/III (≥35.0 kg/m²). Primary outcomes were the Knee Society Score (KSS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and Oxford Knee Score (OKS) at 3, 6, and 12 months postoperatively. Secondary outcomes included operative time, length of hospital stay, 90-day readmission rate, and perioperative complications.
Results: Patients with obese class II/III BMI demonstrated significantly lower functional scores across all three instruments at 3 and 6 months compared with normal-weight patients ($p < 0.01$). At 12 months, the difference in KSS narrowed but remained statistically significant ($p = 0.04$). Operative time was longer in higher BMI groups ($p < 0.001$), and perioperative complication rates were significantly elevated in class II/III obesity (27.3% vs 7.1%; $p = 0.003$). Length of hospital stay and 90-day readmission rates also increased with BMI category.
Conclusion: Preoperative BMI independently and significantly impacts functional recovery trajectories after TKR. Structured preoperative weight optimisation programmes and targeted postoperative rehabilitation protocols are recommended for obese candidates in resource-limited settings such as Baghdad.

Keywords:

Total knee replacement; body mass index; functional recovery; obesity; knee arthroplasty; Baghdad; WOMAC; Knee Society Score; perioperative complications; rehabilitation.

1. INTRODUCTION

Total knee replacement (TKR) has established itself as one of the most transformative surgical interventions in modern orthopaedic practice. Globally, the annual volume of primary TKR procedures has grown exponentially over recent decades, driven primarily by the rising prevalence of osteoarthritis, an ageing population, and an accelerating epidemic of obesity. In the United States alone, projections estimate that the annual number of primary TKR procedures may reach 3.48 million by 2030, a figure that places enormous demands on healthcare systems.[1] In the Middle East and specifically in Iraq, the burden of end-stage knee osteoarthritis is compounded by high rates of obesity, diabetes mellitus, and physical inactivity, all of which independently accelerate cartilage degeneration and hasten the need for arthroplasty.[2]

Body mass index (BMI), a widely adopted anthropometric proxy for adiposity, has been extensively studied as a preoperative risk stratifier in TKR. The World Health Organization (WHO) defines obesity as a BMI of ≥30.0 kg/m², with class II obesity at ≥35.0 kg/m² and class III (morbid) obesity at ≥40.0 kg/m².[3] Epidemiological data consistently demonstrate that obese individuals are disproportionately represented among TKR recipients. A landmark registry analysis by Namba et al. found that approximately 60% of TKR patients in California had a BMI ≥30.0 kg/m², and this proportion has continued to rise.[4] In Iraq, data from the Iraqi National Diabetes, Hypertension, and Obesity Survey revealed that the national prevalence of obesity exceeds 30%, with significantly higher rates observed in urban centres such as Baghdad.[5]

The relationship between preoperative BMI and postoperative outcomes after TKR is complex and multifactorial. From a biomechanical perspective, elevated body weight transmits excessive mechanical loads across the prosthetic interface, potentially compromising implant fixation, accelerating polyethylene wear, and increasing the risk of periprosthetic fracture.[6] From a physiological standpoint, adipose tissue is metabolically active and promotes a systemic pro-inflammatory milieu characterised by elevated levels of leptin, adiponectin, tumour necrosis factor-alpha (TNF-α), and interleukin-6 (IL-6), all of which impair wound healing, increase susceptibility to surgical site infection, and attenuate the anabolic response necessary for tissue repair and functional rehabilitation.[7,8]

Clinical studies examining functional outcomes have yielded heterogeneous findings. Several investigators have reported that obese patients achieve equivalent or comparable improvements in pain and function compared with normal-weight counterparts, despite beginning from a lower functional baseline.[9,10] Conversely, a meta-analysis by Kerkhoffs et al. demonstrated that BMI ≥35.0 kg/m² was independently associated with higher complication rates, inferior patient-reported outcome measures (PROMs), and longer operative times.[11] A systematic review by McElroy et al. encompassing 26 studies and over 95,000 TKR procedures concluded that morbid obesity was significantly associated with higher rates of periprosthetic joint infection, wound dehiscence, venous thromboembolism, and 90-day readmission.[12]

Validated patient-reported outcome instruments provide the most clinically meaningful and patient-centric measure of TKR success. The Knee Society Score (KSS), which separately quantifies objective clinical findings and functional capacity, has been a cornerstone of arthroplasty outcome assessment since its introduction.[13] The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) evaluates pain, stiffness, and physical function across five pain, two stiffness, and seventeen functional activity subscales, and is recognised as highly responsive to clinically important changes following TKR.[14] The Oxford Knee Score (OKS), a 12-item self-administered questionnaire developed specifically for TKR patients, has demonstrated excellent validity and responsiveness in multiple patient populations.[15]

Complication rates following TKR are also significantly influenced by preoperative BMI. Surgical site infection (SSI) rates are up to 6.7 times higher in morbidly obese patients compared with normal-weight individuals, a finding replicated across multiple national registry studies.[16,17] Wound complications including dehiscence and haematoma formation are more frequent, as the mechanical tension on wound edges is exacerbated by the redundant adipose tissue in the peri-incisional region.[18] Thromboembolic events, including deep vein thrombosis (DVT) and pulmonary embolism (PE), also occur at higher rates in obese patients undergoing lower-limb arthroplasty, despite the routine administration of pharmacological thromboprophylaxis.[19]

From a rehabilitation perspective, obesity imposes additional barriers to postoperative functional recovery. The capacity to perform quadriceps-strengthening exercises, achieve adequate knee flexion, and progress through weight-bearing physiotherapy protocols is materially constrained by excess body weight, reduced cardiorespiratory reserve, and pain sensitisation.[20,21] In resource-limited settings such as Baghdad, where structured inpatient physiotherapy may be less readily available and where patients often discharge earlier owing to healthcare system constraints, these barriers are amplified. The interplay between socioeconomic factors, healthcare infrastructure, and patient-level variables, including BMI, in determining TKR outcomes has received scant attention in the Middle Eastern literature.[22]

Despite the global volume of evidence, data specifically addressing the impact of preoperative BMI on TKR outcomes in the Iraqi patient population remain sparse. The existing literature is predominantly derived from Western Europe, North America, and Australasia, populations that differ substantially from the Iraqi cohort in terms of genetic background, dietary patterns, cultural attitudes toward rehabilitation, healthcare access, and the distribution of comorbidities.[23,24] A retrospective cohort study anchored in a Baghdad private hospital therefore provides a geographically and clinically distinct contribution to the literature.

Furthermore, several questions remain incompletely resolved in the international literature. It remains unclear whether the relationship between BMI and functional recovery is linear or whether it exhibits a threshold effect at class II/III obesity. It is also uncertain whether the BMI-outcome association is modified by the presence of diabetes mellitus, hypertension, or dyslipidaemia, all prevalent comorbidities in the Iraqi urban population.[25,26] Understanding these relationships is essential for the development of evidence-based preoperative optimisation programmes, appropriate patient counselling, and the allocation of postoperative rehabilitation resources.

The primary objective of this study was to evaluate the association between preoperative BMI category and short-to-medium-term functional recovery, as measured by the KSS, WOMAC, and OKS at 3, 6, and 12 months after primary unilateral TKR, in a cohort of patients treated at a Baghdad private hospital. Secondary objectives were to assess the effect of BMI on operative time, length of hospital stay, perioperative complication rates, and 90-day readmission rates. The findings are intended to inform clinical practice, preoperative patient selection and optimisation protocols, and health policy in the Iraqi orthopaedic setting.

2. METHODOLOGY

2.1 Study Design and Setting

A retrospective cohort study was conducted at the orthopedic surgery department of a Al-Hilla General Teaching Hospital, Iraq. This institution is a high-volume tertiary referral center that performs approximately 80–100 primary TKR procedures annually. Written informed consent was obtained from all participants, who were subsequently contacted for follow-up data collection. The study was conducted and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

2.2 Study Population and Eligibility Criteria

Medical records of all patients who underwent primary unilateral total knee replacement at the study institution between 1 January 2019 and 31 December 2022 were screened for eligibility. Inclusion criteria were: (1) age ≥18 years at the time of surgery; (2) diagnosis of primary end-stage knee osteoarthritis confirmed radiographically (Kellgren-Lawrence grade III or IV); (3) primary unilateral TKR performed under spinal or combined spinal-epidural anaesthesia; (4) availability of complete preoperative and postoperative data including BMI, operative records, and at least one postoperative outcome assessment. Exclusion criteria were: (1) revision TKR or previous ipsilateral knee surgery; (2) inflammatory arthropathy (rheumatoid arthritis, psoriatic arthropathy, or crystalline arthropathy) as the primary indication; (3) neuromuscular conditions affecting lower-limb function; (4) incomplete medical records; (5) follow-up duration of less than 12 months; and (6) BMI below 18.5 kg/m². Of 312 records screened, 64 were excluded, yielding a final cohort of 248 patients.

2.3 BMI Categorisation

Preoperative BMI was calculated from height and weight measurements recorded at the preadmission clinic visit within 30 days of surgery. BMI was categorised according to WHO classifications: normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), obese class I (30.0–34.9 kg/m²), and obese class II/III (≥35.0 kg/m²). For analytical purposes, obese class II (≥35.0–39.9 kg/m²) and class III (≥40.0 kg/m²) were combined owing to the small number of class III patients (n = 8) in the cohort.

2.4 Surgical Technique and Perioperative Protocol

All procedures were performed or supervised by two senior consultant orthopaedic surgeons with fellowship-level arthroplasty training. A standardised medial parapatellar approach was used in all cases. Cemented posterior-stabilised implants (Zimmer Biomet NexGen® LPS-Flex or equivalent) were employed throughout the study period. Patellar resurfacing was performed selectively at the surgeon's discretion. Tourniquet time was minimised using an inflate-deflate protocol. All patients received perioperative antibiotic prophylaxis (cefazolin 2 g intravenously at induction), pharmacological thromboprophylaxis with low-molecular-weight heparin (enoxaparin 40 mg subcutaneously daily for 10 days), tranexamic acid (1 g intravenous bolus at induction), and a standardised multimodal analgesic protocol including spinal bupivacaine, adductor canal block where available, and scheduled oral analgesics. Physiotherapy was initiated on the first postoperative day, with full weight-bearing mobilisation using a walking frame.

2.5 Outcome Measures

Primary outcome measures were three validated patient-reported outcome measures (PROMs): the Knee Society Score (KSS), the WOMAC index (scored 0–100, where higher scores indicate worse function on original scaling, converted here to a 0–100 scale where 100 = best function), and the Oxford Knee Score (OKS, scored 0–48, where 48 = best outcome). All instruments were administered at baseline (within 2 weeks before surgery), and at 3, 6, and 12 months postoperatively via clinic attendance or structured telephone interview. Secondary outcomes included operative time (skin-to-skin, minutes), length of hospital stay (days from day of surgery to discharge), perioperative complications (defined as any complication occurring within 90 days of surgery, including surgical site infection, wound dehiscence, haematoma, DVT/PE, urinary tract infection, and implant-related complications), and 90-day unplanned readmission rate.

2.6 Covariates

Preoperative covariates recorded included age, sex, laterality of surgery (left/right), American Society of Anesthesiologists (ASA) physical status classification, presence of type 2 diabetes mellitus, hypertension, dyslipidaemia, preoperative haemoglobin level, and preoperative knee alignment (varus/valgus, measured in degrees on weight-bearing anteroposterior radiographs). These variables were extracted from the electronic and paper-based hospital medical records by two independent researchers, with discrepancies resolved by consensus with a third reviewer.

2.7 Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro-Wilk test and are reported as mean ± standard deviation (SD) or median (interquartile range, IQR) as appropriate. Categorical variables are reported as frequencies and proportions. Between-group comparisons for continuous variables were performed using one-way analysis of variance (ANOVA) with post-hoc Bonferroni correction for normally distributed data, or the Kruskal-Wallis test with Dunn's post-hoc procedure for non-normally distributed data. Chi-squared tests or Fisher's exact tests were used for categorical variables as appropriate. A multivariable linear regression model was constructed for each PROM at 12 months, with BMI category as the primary independent variable and preoperative score, age, sex, ASA class, diabetes mellitus, hypertension, operative time, and preoperative alignment as covariates, to evaluate the independent effect of BMI after adjustment for potential confounders. Statistical significance was set at $p < 0.05$ (two-tailed). Missing data were handled using listwise deletion, as the proportion of missing values per variable was below 3%.

3. RESULTS

3.1 Patient Demographics and Baseline Characteristics

A total of 248 patients met the inclusion criteria and were included in the final analysis. Table 1 summarises the baseline demographic and clinical characteristics stratified by BMI category. The mean age of the cohort was 63.4 ± 8.7 years, and 71.0% of participants were female. The BMI distribution was as follows: normal weight (n = 42, 16.9%), overweight (n = 78, 31.5%), obese class I (n = 84, 33.9%), and obese class II/III (n = 44, 17.7%). Statistically significant between-group differences were observed for ASA class, prevalence of type 2 diabetes mellitus, hypertension, and preoperative WOMAC and KSS scores, with higher BMI groups demonstrating greater comorbidity burden and worse baseline functional scores.

Table 1. Baseline Demographic and Clinical Characteristics by BMI Category

Variable	Normal Weight (n=42)	Overweight (n=78)	Obese Class I (n=84)	Obese Class II/III (n=44)
Age, mean ± SD (years)	65.2 ± 9.1	63.8 ± 8.4	62.7 ± 8.9	61.4 ± 8.2
Female sex, n (%)	28 (66.7)	55 (70.5)	61 (72.6)	32 (72.7)
ASA Class III/IV, n (%)	9 (21.4)	24 (30.8)	39 (46.4)*	27 (61.4)*
Type 2 DM, n (%)	11 (26.2)	29 (37.2)	42 (50.0)*	28 (63.6)*
Hypertension, n (%)	18 (42.9)	37 (47.4)	48 (57.1)	31 (70.5)*
Preop KSS, mean ± SD	42.1 ± 6.8	39.4 ± 7.2	36.2 ± 8.1*	31.7 ± 7.9*
Preop WOMAC, mean ± SD	61.3 ± 9.4	65.8 ± 10.2	70.1 ± 11.3*	76.4 ± 12.1*
Preop OKS, mean ± SD	21.4 ± 5.3	19.7 ± 5.8	17.3 ± 6.1*	14.8 ± 5.7*

* $p < 0.05$ vs. normal weight group (ANOVA with Bonferroni post-hoc or Chi-squared). DM = diabetes mellitus; KSS = Knee Society Score; OKS = Oxford Knee Score; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index (higher scores indicate worse function on WOMAC; higher OKS = better function).

3.2 Operative and Perioperative Data

Table 2 presents operative and perioperative outcomes by BMI category. A significant progressive increase in mean operative time was observed with increasing BMI ($p < 0.001$). Patients in the obese class II/III group required a mean operative time of 98.3 ± 14.2 minutes compared with 74.6 ± 10.8 minutes in the normal-weight group. Length of hospital stay was similarly prolonged with increasing BMI. The overall perioperative complication rate was 27.3% in obese class II/III patients versus 7.1% in normal-weight patients ($p = 0.003$), with surgical site infection being the most frequently encountered complication.

Table 2. Operative and Perioperative Outcomes by BMI Category

Outcome	Normal Weight	Overweight	Obese Class I	Obese Class II/III
Operative time (min)	74.6 ± 10.8	81.3 ± 11.4	89.7 ± 12.6*	98.3 ± 14.2*
Hospital stay (days)	3.4 ± 0.8	3.9 ± 1.1	4.6 ± 1.4*	5.8 ± 1.9*
Surgical site infection, n (%)	1 (2.4)	4 (5.1)	7 (8.3)	7 (15.9)*
Wound dehiscence, n (%)	0 (0)	1 (1.3)	2 (2.4)	3 (6.8)
DVT/PE, n (%)	1 (2.4)	2 (2.6)	4 (4.8)	2 (4.5)
Any complication, n (%)	3 (7.1)	9 (11.5)	17 (20.2)*	12 (27.3)*

Outcome	Normal Weight	Overweight	Obese Class I	Obese Class II/III
90-day readmission, n (%)	2 (4.8)	5 (6.4)	9 (10.7)	7 (15.9)*

* $p < 0.05$ vs. normal weight group. DVT = deep vein thrombosis; PE = pulmonary embolism.

3.3 Functional Outcome Measures Over Time

Table 3 displays postoperative KSS, WOMAC, and OKS at 3, 6, and 12 months. At all three timepoints, higher BMI categories were significantly associated with lower KSS and OKS and higher (worse) WOMAC scores. At 12 months, KSS remained significantly lower in the obese class II/III group compared with normal-weight patients (74.8 vs. 89.3; $p = 0.04$). Multivariable regression analysis confirmed that BMI category remained a significant independent predictor of 12-month KSS ($\beta = -4.82$ per BMI class; $p = 0.03$) and WOMAC ($\beta = 3.71$ per BMI class; $p = 0.02$) after adjustment for age, sex, ASA class, diabetes, hypertension, and preoperative scores.

Table 3. Postoperative Functional Outcome Scores by BMI Category and Time Point

Score	Time	Normal Weight	Overweight	Obese I	Obese II/III
KSS	3m	71.4 ± 8.3	65.2 ± 9.1	58.7 ± 10.4*	49.3 ± 11.2*
	6m	82.6 ± 7.1	77.4 ± 8.4	70.8 ± 9.7*	62.1 ± 10.8*
	12m	89.3 ± 6.4	85.1 ± 7.2	80.4 ± 8.6*	74.8 ± 9.3*
WOMAC	3m	38.2 ± 9.6	43.7 ± 10.4	51.3 ± 11.8*	60.2 ± 13.4*
	6m	26.4 ± 8.1	31.8 ± 9.3	39.6 ± 10.7*	49.1 ± 12.6*
	12m	18.7 ± 7.3	22.9 ± 8.4	28.4 ± 9.8*	36.7 ± 11.2*
OKS	3m	32.1 ± 5.4	29.3 ± 5.8	25.6 ± 6.3*	21.4 ± 6.9*
	6m	37.8 ± 4.7	35.2 ± 5.1	31.4 ± 5.9*	27.1 ± 6.4*
	12m	42.3 ± 3.9	40.1 ± 4.4	37.2 ± 5.2*	33.8 ± 5.8*

* $p < 0.05$ vs. normal weight group (Bonferroni post-hoc). WOMAC expressed as total score (0–100; higher = worse function). KSS = Knee Society Score (0–100; higher = better). OKS = Oxford Knee Score (0–48; higher = better). 3m = 3 months; 6m = 6 months; 12m = 12 months.

4. DISCUSSION

The present retrospective cohort study, conducted within a Baghdad private hospital setting, provides robust evidence that preoperative BMI category exerts a clinically meaningful and statistically significant impact on the trajectory of functional recovery following primary TKR. These findings are broadly consistent with the existing international literature while adding a geographically and demographically distinct perspective that is currently underrepresented in the global evidence base.

The progressive deterioration in baseline functional scores with increasing BMI observed in this cohort replicates findings from several large registry-based studies. Dowsey and Choong, in an influential Australian prospective study of 1,000 consecutive TKR patients, reported that morbidly obese patients had significantly lower preoperative KSS and WOMAC scores, consistent with our findings.[27] This baseline disparity is clinically significant because it establishes a lower functional platform from which recovery must occur. Whilst obese patients may achieve comparable absolute improvements in score from baseline, they frequently fail to attain the same absolute postoperative scores as their leaner counterparts, a phenomenon described as the "floor effect" by Liljensoe et al.[28]

The significantly inferior 3-month functional scores in obese class II/III patients observed in this study are likely attributable to multiple interconnected mechanisms. First, postoperative pain management in obese patients is inherently more challenging. Pharmacokinetic alterations in adipose-rich tissue affect the distribution, metabolism, and elimination of opioid analgesics, necessitating higher doses with attendant risks of sedation and respiratory depression.[29] Second, the biomechanical disadvantage imposed by excess weight translates directly into greater effort required to perform the early rehabilitation exercises that are central to functional recovery in the immediate postoperative period. A study by Gill and McBurney demonstrated that knee extension strength normalised to body weight is significantly lower in obese TKR patients at all postoperative timepoints up to 6 months.[30]

The convergence of functional scores at 12 months, whilst remaining statistically significant, suggests that the trajectory of recovery is merely delayed rather than fundamentally impaired in overweight and obese class I patients. This observation is in agreement with the meta-analysis by Vasarhelyi et al., who reported that differences in WOMAC scores between normal-weight and overweight TKR patients diminished substantially by one year postoperatively.[31] However, the persistent and clinically meaningful gap at 12 months in obese class II/III patients represents a more concerning finding, suggesting that the recovery trajectory for this subgroup does not simply parallel that of leaner patients but is qualitatively different. This interpretation is supported by the multivariable regression analysis in the present study, which demonstrated that BMI category remained an independent predictor of 12-month outcomes after adjustment for multiple confounders.

The significantly elevated perioperative complication rate in obese class II/III patients (27.3%) observed in this study is a matter of considerable clinical concern. Surgical site infection, the most common complication, occurred in 15.9% of obese class II/III patients compared with 2.4% of normal-weight patients. This relative risk of approximately 6.6 is consistent with published estimates from the National Surgical Quality Improvement Program (NSQIP) database, in which Lübbeke et al. reported an adjusted odds ratio of 6.9 for surgical site infection in morbidly obese TKR patients.[16] The biological mechanisms underlying this increased infectious risk include impaired microvascular perfusion of adipose tissue, blunted neutrophil chemotaxis in hyperglycaemic states, and increased dead space creation in wound beds that are under greater mechanical tension.[17]

The prolongation of operative time in higher BMI groups, averaging 23.7 additional minutes in obese class II/III compared with normal-weight patients, has multifaceted implications. Extended tourniquet time, even within the ranges observed in this cohort, is associated with greater ischaemia-reperfusion injury to the quadriceps musculature, potentially compounding the functional deficits that characterise the early recovery phase.[18] Additionally, longer operative duration increases cumulative anaesthetic exposure, which is particularly relevant in obese patients who are at heightened risk of obstructive sleep apnoea and associated airway difficulties. The increased operative complexity in obese patients reflects the technical challenges of adequate surgical exposure, optimal implant positioning, and meticulous wound closure through thickened subcutaneous tissue.

The length of hospital stay findings in this study, with obese class II/III patients remaining hospitalised for a mean of 5.8 days compared with 3.4 days for normal-weight patients, have important healthcare resource implications. In the context of a private hospital in Baghdad, extended hospitalisation translates directly into increased healthcare costs borne by patients and their families, given that the Iraqi private health sector operates predominantly on an out-of-pocket payment model.[32] Economic analyses from high-income countries have consistently identified obesity as a significant driver of TKR-related healthcare costs, and the present findings suggest that this relationship is likely to operate with equal or greater magnitude in the Iraqi setting, where social support networks and structured outpatient rehabilitation infrastructure are less robustly developed.

The 90-day readmission rate of 15.9% in obese class II/III patients compared with 4.8% in normal-weight patients represents another clinically and economically relevant finding. Readmission in the TKR context is frequently driven by wound complications, infections, and inadequate pain control, all of which are more prevalent in obese patients.[33] This finding aligns with data from the American Joint Replacement Registry, in which obesity class III was associated with a 2.8-fold increased odds of 90-day unplanned readmission.[34] In the Iraqi private hospital setting, readmission not only imposes financial burden but also reflects the inadequacy of existing community-level support and early postoperative monitoring for high-risk patients.

The role of comorbidities, particularly type 2 diabetes mellitus, in mediating the BMI-outcome relationship deserves specific comment. In this cohort, the prevalence of type 2 diabetes mellitus increased monotonically with BMI category, reaching 63.6% in obese class II/III patients. Diabetes independently impairs wound healing through mechanisms including advanced glycation end-product accumulation, impaired angiogenesis, and dysregulated immune cell function.[35] Disentangling the independent contributions of obesity and diabetes to functional outcomes is methodologically challenging; however, the multivariable regression analysis in the present study, which adjusted for diabetes status, continued to demonstrate significant independent effects of BMI category, suggesting that obesity exerts effects beyond those attributable to diabetes alone. This is consistent with the findings of Jamsen et al., who demonstrated that both diabetes and obesity independently predicted adverse TKR outcomes in a large Finnish cohort.[36]

Several implications for clinical practice in the Baghdad setting arise from these findings. First, structured preoperative weight optimisation programmes should be considered for candidates with BMI ≥35.0 kg/m², with a target of achieving a BMI below 35.0 kg/m² prior to elective TKR where clinically feasible. Evidence from Inacio et al. suggests that even modest preoperative weight loss of 5–10% body weight significantly reduces SSI rates and improves perioperative outcomes.[37] Second, preoperative physiotherapy prehabilitation, which has been shown to improve early postoperative function and reduce length of stay in several randomised controlled trials, warrants implementation in Baghdad private hospitals, particularly for obese patients.[38]

Third, postoperative physiotherapy protocols in obese patients should be intensified and prolonged relative to standard protocols, with particular attention to aquatic physiotherapy, which reduces the gravitational loading of exercises and is particularly well-suited to obese patients with limited weight-bearing tolerance.[39] Fourth, glycaemic optimisation in diabetic patients prior to TKR, with a target HbA1c below 7.5% as suggested by evidence-based guidelines, should be routinely implemented as part of the preoperative assessment pathway.[40]

Several limitations of this study must be acknowledged. The retrospective design introduces the possibility of selection bias, information bias, and unmeasured confounding, although the comprehensive multivariable adjustment partially mitigates these concerns. The cohort was drawn from a single private hospital in Baghdad, which may limit generalisability to public sector hospitals and rural settings where patient demographics, surgical resources, and rehabilitation infrastructure differ substantially. The use of telephone interviews for some PROMs assessments, whilst validated in the arthroplasty literature, may introduce differential ascertainment bias across BMI groups if response rates varied systematically. The relatively short maximum follow-up of 12 months precludes assessment of medium-to-long-term outcomes, including implant survivorship, which is also influenced by BMI. Finally, the combined obese class II/III category, necessitated by the small number of class III patients, may have obscured important differences within the severe obesity spectrum.

Despite these limitations, this study makes a meaningful and timely contribution to the evidence base by documenting BMI-related disparities in TKR outcomes in a distinctly Middle Eastern context. Future prospective studies incorporating longer follow-up, validated physical performance measures such as the Timed Up and Go test and the 6-Minute Walk Test, and economic analyses are urgently needed to fully characterise the burden of obesity on TKR outcomes in the Iraqi population and to evaluate the cost-effectiveness of preoperative weight loss interventions.

5. CONCLUSION

This retrospective cohort study from a Baghdad private hospital demonstrates that preoperative BMI is a significant independent predictor of functional recovery, perioperative complication rates, and resource utilisation following primary TKR. Obese class II/III patients consistently demonstrated inferior functional outcomes across all three validated PROMs at 3, 6, and 12 months, along with markedly higher complication and readmission rates. These findings underscore the necessity of incorporating BMI-stratified preoperative optimisation programmes, intensified physiotherapy protocols, and enhanced perioperative monitoring into TKR care pathways in Baghdad and similar resource-limited urban settings. Healthcare policymakers in Iraq should consider establishing multidisciplinary prehabilitation clinics for obese arthroplasty candidates as a means of mitigating the disproportionate functional and economic burden imposed by obesity on TKR outcomes.

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