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Functional Outcomes with Primary Total Knee Replacement in Respect to Body Mass Index

Saddam Mazar[1], *Imtiaz A. Hashmi*[1], *Muhammad Sohail Rafi*[1]
[1]*Department of Orthopaedics & Spine Surgery, Dr. Ziauddin University Hospital, Karachi, Pakistan.*

ABSTRACT

Background: Osteoarthritis (OA) is a prevalent condition and the leading disability among the elderly. Obesity, linked to a sedentary lifestyle, increases the risk of OA. Knee Osteoarthritis has improved functional outcomes after Total Knee Replacement (TKR). This study aimed to determine the functional outcomes of primary TKR based on BMI.

Methods: This Prospective Cohort Study, was conducted at Dr Ziauddin Hospital Karachi, from October 2019 to October 2020. Patients of both genders, above the age of 45 years, with knee joint osteoarthritis grade III and IV advised primary TKR, were included. Functional outcomes were assessed using the Knee Society Score, preoperatively and postoperatively, in obese and non-obese groups. The non-probability Convenience Sampling technique was used. SPSS v25.0 and Microsoft Excel 2016 were used for analysis. Chi-square and t-tests were applied, with significance set at $p < 0.05$.

Results: The study included 98 knees in 66 cases, with 30 patients in the obese group and 36 patients in the non-obese group. In the obese group, 28 (93.3%) were over 60 years old, compared to 35 (97.2%) in the non-obese group. The obese group had 23 (76.7%) female patients, while the non-obese group had 22 (61.1%). Postoperative Knee Society Scores were 84.83±4.71 for obese group and 87.08±4.07 for non-obese group. Excellent functional outcomes were achieved by 17 (56.6%) obese and 22 (61.1%) non-obese patients.

Conclusion: BMI should not exclude patients from TKR, but they should be informed of the associated risks, considering the difference in postoperative functional outcomes in both groups.

Keywords: Outcome Assessment, Patient, Total Knee Arthroplasty, Total Knee Replacement, BMI, Osteoarthritis, Arthroplasties, Replacement, Knee

Corresponding Author:
Dr. Saddam Mazar,
Department of Orthopaedics & Spine Surgery,
Dr. Ziauddin University Hospital, Karachi, Pakistan.
Email; drmazar@gmail.com
ORCID; https://orcid.org/0000-0002-9426-5100
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INTRODUCTION

Osteoarthritis (OA) is a prevalent condition among the elderly and a leading cause of disability. Knee OA is becoming common as the mean age of the population has increased [1]. Knee OA is commonly caused by weight, age, and joint damage caused by repetitive motions, mainly kneeling and squatting [1]. TKR is a successful surgical therapy for knee osteoarthritis, with 700,000 operations performed yearly in the US and a 673 percent rise in demand by 2030 [1]. The exponential rise in obesity is occurring in parallel with this growth in demand. In Ireland, 36 percent of the population is overweight, with 14 percent obese [2]. Biochemically, Knee OA is caused by several causes, including cytokines and leptin. OA is a common disease that causes impairment, especially among the elderly[2]. The interaction between local and systemic variables causes OA to have multiple etiologists[2]. Many risk factors along with age influence an individual to OA, like race, gender, recreational or occupational activities, bone density muscle weakness, joint laxity, joint injury, obesity, and genetics [3, 4].

Obesity is a complicated condition in which aberrant activation of the pro-inflammatory pathways and neuroendocrine leads to impaired regulation of food intake, fat growth, and metabolic abnormalities. In 2016, more than 1.9 billion people were overweight; of these, more than 650 million were categorized as obese in Pakistan [5]. White adipose tissue gets activated and it in turn boosts the production of the pro-inflammatory cytokines including IL-18, TNF alpha, IL-1, IL-8, and IL-6 while lowering the production of the regulatory cytokines like IL-10 [6,7]. Knee OA, a common condition characterized by persistent discomfort, decreased function, and joint mobility limitations, often worsened by exercise and relieved by rest. In OA patients, short-term stiffness lasting < 30 minutes may occur in the morning or after periods of inactivity [8,9]. Synovitis can develop in advanced instances, leading to discomfort when sleeping or resting [10].Knee OA has improved functional outcomes after surgical management with TKR. Considering the increasing incidence of this degenerative disease, its relation to obesity in our society becomes important. It is also known that the risk of many other acute and chronic diseases increases due to obesity [11, 12]. Obesity, linked to sedentary lifestyles, increases osteoarthritis risk in weight-bearing joints, increasing demand for TKR. Obesity also has other complications that require surgical intervention[7]. Obesity has established important separate risk factors, thus the functional outcomes after TKR in obese patients in comparison to non-obese is important [7, 8, 9]. Effective management of obesity involves lifestyle modifications, pharmacological therapies, and surgical treatments, which provide health benefits and reduced mortality rates for severe cases[8]. The study aimed to find out the functional outcome of Body Mass Index (BMI) in primary TKR in non-obese and obese patients.

METHODS

A Prospective Cohort Study was carried out at Dr. Ziauddin Hospital Karachi, Clifton from October 2019 to October 2020 after acquiring Ethical Review Committee approval (ERC Ref Code: 1360819SMORT, October 2019). 98 knees (32 bilateral TKR and 34 unilateral TKR) in 66 cases, including 30 patients in obese group and 36 patients in the non-obese group, were diagnosed with Knee Osteoarthritis. The overweight patients will be between 25-29.9 kg/m2 of BMI and Obesity is classed with a BMI of 30 kg/m2 or greater [3], [4].The non-Probability Convenience Sampling technique was used and sample size was calculated using the open epi version 3.01 with means and standard deviations from the parent study [13]. The confidence level used was 90%, Power was 80%, Ratio of sample size, and Unexposed/Exposed was 1. While Percent of Unexposed with Outcome was taken as 90, and Percent of Exposed with Outcome as 70. The odds ratio was taken as 0.26, the Risk/Prevalence Ratio as 0.78, and the Risk/Prevalence difference as -20, with the variables of average time to ambulate and differences in activity scores. Each group comprised 49 knees established. Inclusion criteria included patients of both genders, of any race and age above 45 years, requiring Primary TKR due to Osteoarthritis grade III and above, and failing physiotherapy and pain management techniques. Exclusion criteria comprised all patients with etiologist for TKR other than osteoarthritis, due to trauma, infection or Rheumatoid arthritis, Septic Arthritis, and Congenital Abnormalities. Also, those undergoing concurrent hip or Spine surgeries with TKR, with previous TKR (requiring revision surgery), and with unsatisfactory perambulatory status, were excluded from the study.

Primary Total Knee Replacements were performed by arthroplasty-trained surgeons. The anterior medial parapatellar surgical technique was followed. Antibiotics were given 30 minutes before the incision. Bone cuts were made with intramedullary and extramedullary alignment systems, mechanical alignment was restored, and ligament balancing performed. The joint line level was reconstructed. Ligaments balancing with appropriate releases were performed. If the patellofemoral joint was resurfaced where it was significantly arthritic. Polymethyl methacrylate cement was used to insert definitive prosthetic components into position. Distal neurovascular status is checked after the procedure. Intraoperative epidural, patient-controlled intravenous, or oral analgesia are all options for analgesia. Cryotherapy is used to relieve swelling and discomfort after surgery. Physiotherapy began immediately and continued post-discharge, which typically occurred within 5 to 7 days. Drains were removed within 24–48 hours, walking started on day two, and thromboembolism prophylaxis continued at home. Follow-ups occurred at 2 weeks for suture removal and assessment.

For patients fulfilling inclusion criteria, preoperatively, demographic data including age, gender, and BMI was collected for each patient. They were also assessed before and after 3 months of TKR, in both obese and non-obese groups, using the Knee Society Score (KSS), providing a record of Functional Outcomes along with other assessments of pain. A Knee Society Score (KSS) interprets a patient's knee function based on a 100-point scale, where a higher score indicates better knee function, with a score of 100 representing a completely pain-free knee with a full range of motion and stability; generally, scores above 90 are considered excellent, 70-80 good, 50-60 fair, and below 50 poor. A significant part of the KSS is the "function score" which specifically evaluates how well a patient can perform daily activities like walking and climbing stairs [14]. The data was analysed by using SPSS v25.0 and Microsoft Excel 2016. Quantitative variables were presented as Mean±SD. Qualitative variables were presented as frequency with percentage. Chi-square and t-tests were used. All p-values were evaluated against a threshold of 0.05 for significance.

RESULTS

A study of 30 obese and 36 non-obese patients observed 98 knees, including 32 bilateral and 34 unilateral TKR. In our study, we encountered 2 (3%) patients with superficial wound infection, treated with regular dressing and oral antibiotics, with total recovery.

Table 1: Comparison of Variables Among the Two Groups

	Group		Total	p-value
	Obese	Non-Obese		
Male	7	14	21	0.177
	23.3%	38.9%	31.8%	
Female	23	22	45	
	76.7%	61.1%	68.2%	
Unilateral TKR	11	23	34	0.028
	36.7%	63.9%	51.5%	
Bilateral TKR	19	13	32	
	63.3%	36.1%	48.5%	
Age (Mean±SD)	59.27±6.42	62.58±4.87	61.53 ± 5.40	0.023
Equal & Below	2	1	3	0.450
Above 60 years	28	35	63	
	93.3%	97.2%	95.5%	
Total	30	36	66	
	100.0%	100.0%	100.0%	

The Chi-square test and t-test were used in the above table.

Table 1 compares variables between obese and non-obese groups, highlighting differences in gender, type of total knee replacement (TKR), and age. Females dominate the study population (68.2%), and most participants are above 60 years (95.5%). Significant differences are noted in unilateral TKR distribution (p=0.028), with more non-obese individuals undergoing this procedure, and in mean age (p=0.023), where non-obese participants are slightly older.

Figure 1 shows a significant improvement in Knee Society Scores post-operatively for both study groups, with the non-obese group slightly higher (87.08) compared to the obese group (84.83), and similar pre-operative scores (41.14 vs. 40.37).

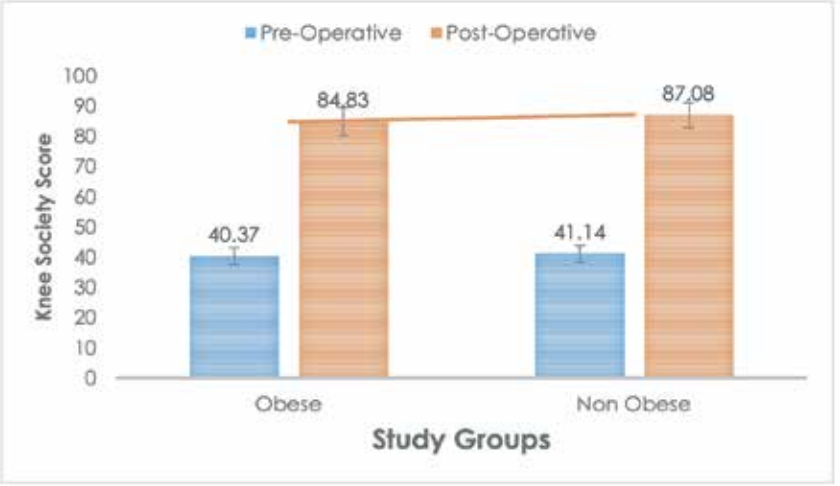

Figure 1: Bar graph of the results of the Pre- & Post-Operative Knee Society Score among the groups

Table 2: Comparison of Post-Operative Functional Outcomes Between the Groups

Post-Operative Functional Outcome	Group			p-value
	Obese	Non-Obese	Total	
Excellent	17 (56.7%)	22 (61.1%)	39 (59.0%)	0.026
Good	6 (20.0%)	13 (36.1%)	19 (28.8%)	
Fair	5 (16.7%)	1 (2.8%)	6 (9.1%)	
Poor	2 (6.7%)	0 (0.0%)	2 (3.0%)	
Total	30 (100.0%)	36 (100.0%)	66 (100.0%)	

Table 2 compares post-operative functional outcomes between obese and non-obese groups. Non-obese participants show better outcomes, with 61.1% achieving excellent and 36.1% good results compared to obese participants (56.7% and 20.0%, respectively). A significant difference is observed (p=0.026), as obese individuals with a significant difference in fair (16.7%) and poor (6.7%) outcomes, respectively.

Table 3: Comparison of Post-Operative Functional Outcomes Between the Groups w.r.t Gender

Gender	Post-Operative Functional Outcome	Group			p-value
		Obese	Non-Obese	Total	
Male	Excellent	3 (42.9%)	9 (64.35)	12 (57.1%)	0.092
	Good	4 (57.1%)	4 (28.6%)	8 (38.1 %)	
	Fair	0 (0.0%)	1 (7.1%)	1 (4.8%)	
	Poor	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	Total	7 (100%)	14 (100%)	21 (100%)	
Female	Excellent	14 (60.9%)	13 (59.1%)	27 (60%)	0.022
	Good	2 (8.7%)	9 (40.9%)	11 (24.4%)	
	Fair	5 (21.7 %)	0 (0.0%)	5 (11.1%)	
	Poor	2 (8.7%)	0 (0.0%)	2 (4.4%)	
	Total	23 (100%)	22 (100%)	45 (100%)	

Table 3 compares post-operative functional outcomes between obese and non-obese groups based on gender. No significant difference is observed among males, with similar rates of excellent outcomes. However, non-obese women have better outcomes (40.9%) compared to obese women (21.7% fair and 8.7% poor), highlighting the impact of obesity on post-operative outcomes, especially in females.

Fig 2 demonstrates that postoperative functional outcomes were excellent in 62.2% of patients aged ≤ 60 years, with a significant difference between obese and non-obese individuals. In patients aged > 60 years, excellent outcomes were observed in 52.4%, with a higher percentage of non-obese patients achieving "good" and "excellent" outcomes compared to obese patients.

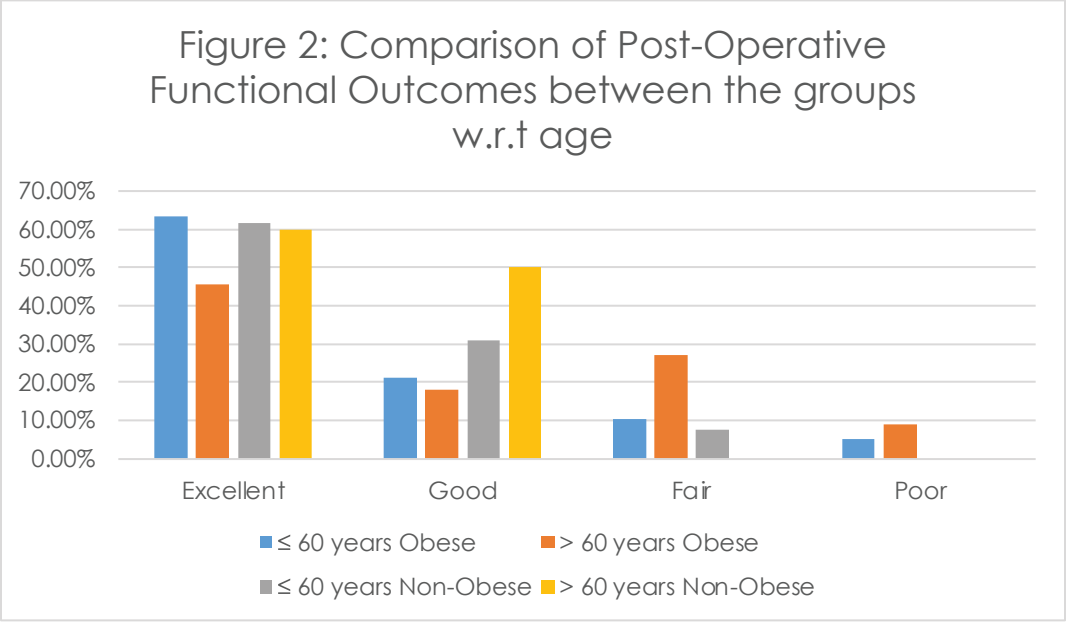

Figure 2: Comparison of Post-Operative Functional Outcomes Between the Groups w.r.t Age

DISCUSSION

The data is currently mixed, with some research indicating that obese individuals have poorer outcomes [9] and others indicating that they have similar functional outcomes [11, 15]. In this study, it was found the age of patients in our study was 59.27±6.41 years in obese group patients and 62.58±4.87 years in non-obese group. Obese group had 7(23.3%) male and 23(76.7%) female. Similarly, in non-obese groups 14(38.9%) were male and 22(61.1%) were female.

The average age of patients in a prospective study of 50 TKR was 63 years[16, 17]. Out of 50 patients in the study, 37 were females and 13 were males, indicating that females are more likely than males to get a complete knee replacement. The score of Knee Society was 45-81[5].

The post-operatively knee society score in the obese group was 84.83±4.71 and in the non-obese group was 87.08±4.07. Functional outcome results of the obese group showed that 17(56.6%) patients had excellent outcomes and in the non-obese group 22(61.1%) patients had excellent outcomes. Both the groups showed comparably better functional outcome results in total knee replacement.

The average knee society score preoperative was 52.3±11.2, whereas the knee society score postoperative was 93.7±4.49, with 43.5 percent graded excellent, according to research [16]. Another survey found that 71.8 percent of people evaluated themselves as outstanding [18]. Patients with normal BMI had no difference in the short-term TKR functional outcome when compared to those who were overweight or obese, according to the research [16, 19, 20]. This conclusion is consistent with earlier research, which found that a significant percentage of patients receiving TKR are now obese [3, 21]. This emphasizes the current and future strain that a rise in BMI will impose on orthopaedic care. Obesity is not directly related to the early OA of the knees, but it also affects the overall fitness of the patient[22]. If a patient is obese, it is related to systemic changes, resulting in a sedentary lifestyle and difficulty in participating in activities of daily life, in turn leading to more increase in weight and more pressure over the knees. And leading to progressive disability[23]. With rising BMI, the development of deep peri-prosthetic & superficial joint infections and wound healing become much more prevalent[24, 25]. In an examination of 15276 and 5061 individuals, it was found that an odds ratio of 1.9 for all the infections and 2.38 for the deep infection in obese patients compared to non-obese patients in a meta-analysis[9]. Patients must be well informed about the increased risk of the perioperative problems that come with rising BMI. While it may

seem obvious that patients should try to lose weight before surgery, new research shows that obese individuals who shed a large proportion of their body weight before surgery have a greater incidence of SSI (3.77%) than control patients [9].

In our study, we encountered 2 (3%) patients with superficial wound infection, treated with regular dressing and oral antibiotics, with total recovery.
This study encountered a few limitations as the potential single-centre design may limit the generalizability of the results to broader patient populations or surgical practices. Moreover, the findings might be influenced by the duration of follow-up (short-term analysis of functional outcomes). Also, the differences in implant types could introduce variability in outcomes that are challenging to control. The primary strength of this study lies in its focused examination of the relationship between body mass index (BMI) and functional outcomes following primary total knee replacement (TKR). The use of standardized assessment tools, such as the Knee Society Score, enhances the reliability and comparability of the results.

It is crucial to establish guidelines or protocols that discourage the outright refusal of TKR in obese patients, but rather encourage comprehensive assessments of individual factors including overall health, comorbidities, and patient goals, which can be instrumental.

CONCLUSION

There was a difference in postoperative functional outcomes between normal-weight persons and those with BMI > 25. Patients must be informed about the increased risk of problems that come with growing BMI, but should not be rejected TKR based simply on their weight if they are medically fit. In individuals with osteoarthritis, total knee replacement improves functional results considerably. Though less prevalent, problems like wound issues and infection are more common in obese patients after TKR. For TKR in knee joint osteoarthritis patients, adequate patient counselling and a well-executed surgical technique are recommended.

LIST OF ABBREVIATIONS

OA: Osteoarthritis
TKR: Total Knee Replacement
TKA: Total Knee Arthroplasty
KSS: Knee Society Score
BMI: Body Mass Index
JSN: Joint Space Narrowing
RA: Rheumatoid Arthritis
ROM: Range of Movement

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CONFLICT OF INTEREST

None

ETHICAL APPROVAL

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AUTHOR CONTRIBUTIONS

SM: Responsible for the conceptualization, writing, design, data collection, analysis, and interpretation, as well as the drafting and revision of the manuscript, **IAH** provided valuable guidance, contributed to manuscript drafting, and assisted in study design and methodology, while also providing critical feedback on the manuscript, **MSR** was responsible for study design, data analysis, interpretation, and feedback on the manuscript.

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