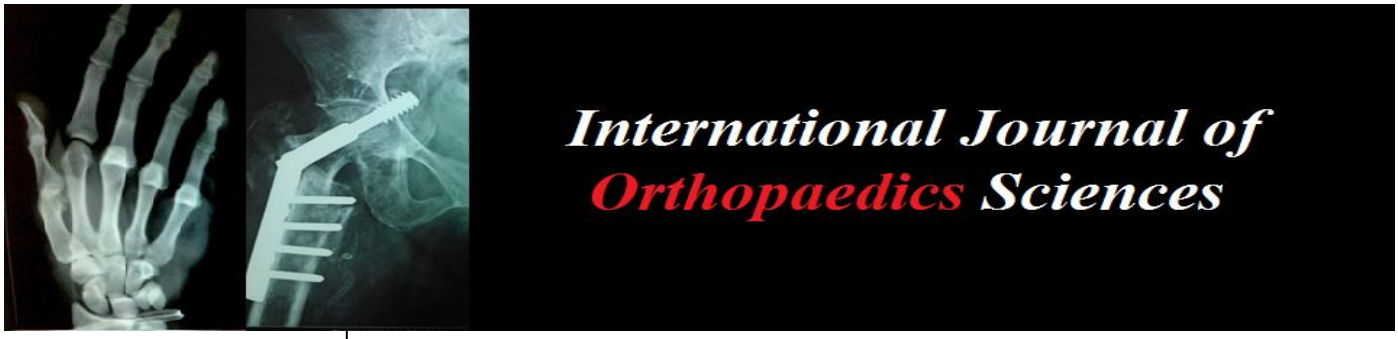

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The effect of body mass index on functional outcome in total knee replacement

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Abstract
Background: Osteoarthritis is one of the leading causes of disability. TKR is the most common procedure for end stage arthritis. Although obesity is assumed to bring out a negative influence on survival of TKR, there is no definitive proof in literature. The impact of obesity on the outcomes of TKA is still debated.
Aim: To investigate the effects of body mass index on the rehabilitation process in patients with a recent TKR.
Design: This prospective study included patients (N= 50) who underwent TKR between 2018 and 2019 for primary OA.
Materials and Methods: Patients undergoing TKR were identified from a prospective arthroplasty database. 50 patients were included in the study. Age, gender, BMI, pre- and post-operative functional scores [International knee society score: KSS], complications were recorded. WHO BMI classification was used to group the patients. The functional outcome of the normal weight group (BMI < 25) was compared to the overweight and obese group (BMI ≥ 25).
Results: Mean age in the study was 65.8 (52-78). 60% (30) were female. The mean BMI was 28.8 (18-52). 70% of patients were either overweight or obese. Mean follow-up was 12.33 mo (6-24 mo). No significant difference was identified in pre or post-operative KSS in normal weight (BMI < 25) group compared with that of patients with a BMI ≥ 25. Overall, there was 1 case of infection (2%), with no complications or revisions in the normal weight group (BMI < 25)
Conclusion: BMI did not show any influence on post-operative outcome comparing normal weight individuals and the ones with BMI > 25. Patients should not be denied total knee replacement based solely on BMI alone.

Keywords: Total knee replacement, body mass index, total knee arthroplasty, osteoarthritis.

Introduction
Knee osteoarthritis (OA) is one of the leading causes of disability and it affects over 250 million people worldwide [1]. Joint arthroplasty for knee is one of the most common elective and cost-effective surgical intervention for end stage lower-limb arthritis [1]. Occurring in company with this increase in demand is the exponential increase in obesity in society [2]. It is well known that obesity increases the risk of a number of medical conditions like diabetes, ischaemic heart disease and stroke [3]. It is also shown that obesity is an independent risk factor for development of knee osteoarthritis [4]. Obesity has a number of implications for surgery in general, but in particular for elective surgery such as TKA, obesity is an independent risk factor for a number of complications including wound infection, acute coronary syndrome and UTI [5]. Although obesity is assumed to bring out a negative influence on survival of TKR, there is no definitive proof in literature. The impact of obesity on the outcomes of TKA is still debated. A systematic review of the literature [6] showed that deep infection and revision for any reason were more often in obese patients than in non-obese patients, but another recent systematic review [7] found that overall obese patients did not have significantly lower knee scores. The aim of the study was to assess the effect of (BMI) on functional outcome following primary total knee arthroplasty.

Materials and Methods

- Data was compiled during a 2-year period from November 2017 through November 2019 from consecutive patients who underwent TKA for primary Osteoarthritis. A total of 50 patients were included in the study. Pre operatively body mass index (BMI) was calculated for each patient using the standardized formula; weight in kilograms squared, divided by height in meters squared. International knee society scores were collected pre and post-operatively at 6, 12 and 24 month intervals. Complications included one case of deep infection requiring subsequent revision.
- Patients were divided into two groups for the purpose of the study, those with a normal BMI (less than or equal to 25) in Group 1 and those who were overweight or obese (greater than 25) in Group 2 according to the WHO BMI classification [8]. A sub-group analysis was also performed comparing all five WHO BMI groups namely normal weight, overweight, class 1 obese, class 2 obese and class 3 obese.
- The primary outcomes assessed were pre-operative and 1year post-operative KSS. Originally published in 1989 in Clinical Orthopaedics and Related Research, the Knee Society Clinical Rating System (KSS) was designed to provide a simple and objective scoring system to assess the knee and patient's functional abilities before and after total knee arthroplasty. [9]
- The original KSS has two sections namely "Knee Score" (7 items) and "Functional Score" (3 items). Both are scored from 0 to 100 with knee conditions improving from lower to higher scores.

Statistical Analysis

- All the data was collated on a Microsoft Excel spreadsheet. Results were analysed and were presented as percentage, mean and standard deviation for each BMI group. Statistical significance was assessed between the study groups using the student t test, with significance set at $P < 0.01$.
- A further sub-group analysis was performed comparing each of the WHO BMI sub-groups with significance set at $p < 0.01$.

Table 1: BMI Classification

Who BMI Classification	
Under- Weight	< 18.5
Normal	18.5-24.9
Over Weight	25-29.9
Obese-I	30-34.9
Obese-II	35-39.9
Obese-III	≥ 40

Table 2: International Knee Society Scoring

Part 1 : Knee Score	Part 2 : Functional Score
1.Pain None- 50 MILD/OCASSIONAL- 45 MILD (Walking and Stairs)- 30 Moderate (Ocassional)- 20 Moderate (Continual)- 10 Severe- 0	1.Walking (1 Block = 100MTS) Unlimited: 50 >10 Blocks: 40 5-10 Blocks: 30 <5 Blocks: 20 House Bound: 10 Unable: 0
2. Range of Motion -1 Point for Every 5 Degrees	
3. Stability a) Anterio-Posterior <5MM – 10 5-10MM – 5 >10MM- 0 b) Medio -Lateral <5 Degrees: - 15 6-9 Degrees: 10 10-14 Degrees: 5	2.Stairs Normal up and Down: 50 Normal up and Down With Rail Support:40 Up and Down With The Support of Rail: 30 Up With Support of Rail Unable to Climb Down: 15 Unable: 0
4. Flexion Contracture 5-10 Degrees: -2 10-15 Dgerees: -5 16-20 Degrees: -10 >20 Degrees: -15	3.Walking aid used None: 0 Cane/Stick: -5 Two Sticks/Cane: -10 Crutch: -15
5. Extensor LAG < 10 Degrees: -5 10-20 Degrees: -10 >20 Degrees: -15	
6.Alignment (Varus /Valgus) 5-10 Degrees: 0 0-4 Degrees: 3 Points FOR EACH Degree 10-15 degrees: 3 Points for Each Degree	**Grading** Excellent: 80-100 Good: 70-19 Fair: 60-69 Poor: <60

Results

- A total of 50 primary total knee replacements were performed in the institution between 2017 and 2019. The mean age was 65.8 years (52-78), with 40% Male and 60% Female. The mean follow-up was 12.3 months, with a range of 6 mo to 2 years. The distribution according to BMI group is shown in Figure1. The mean BMI was 28.8 (18-52) with 30% obese, 40% overweight and 30% normal weight. The two comparative study groups consisted of Group 1 (n = 15 patients) and Group 2 (n = 35 patients).

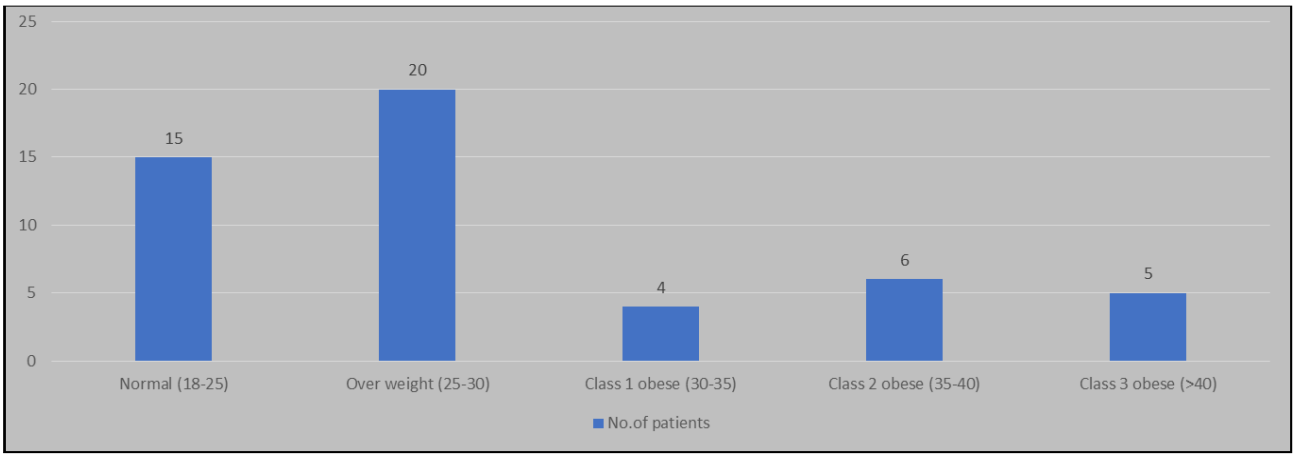

Fig 1: Distribution according to BMI group

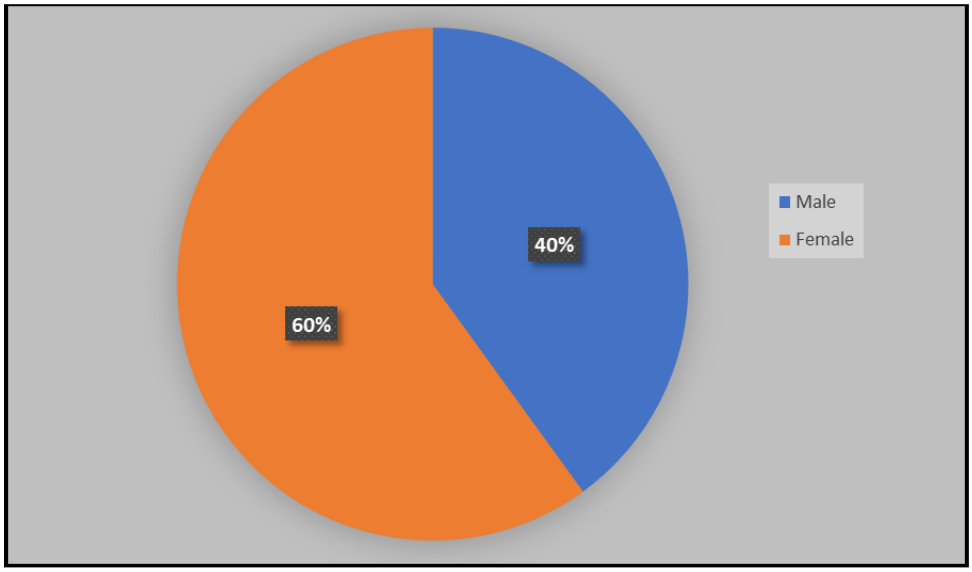

Fig 2: Sex Distribution

Functional Outcome

There was no significant difference in the pre-op scores between Group 1; 56.4 (48-56) and Group 2; 52.6 (32- 52) (*P* = 0.05). Similarly, there was no significant difference in the post op scores between the two groups, 88.6 (82-94) and 82.5 (72-86) (*P* = 0.05) respectively. The complete functional outcome scores are presented in Tables 3 and 4

Table 3: Pre and post-operative functional scores

Functional Score	Group 1 (BMI < 25)	Group 2 (BMI>25)
Pre-operative	56.4	52.6
1-year post-operative	88.6	82.5

Table 4: Sub group analysis of post-operative knee society scores

BMI	1-year postoperative Functional Score
Normal	88.6
Over weight	86.2
Class 1 obese	84.8
Class 2 obese	80.4
Class 3 obese	78.6

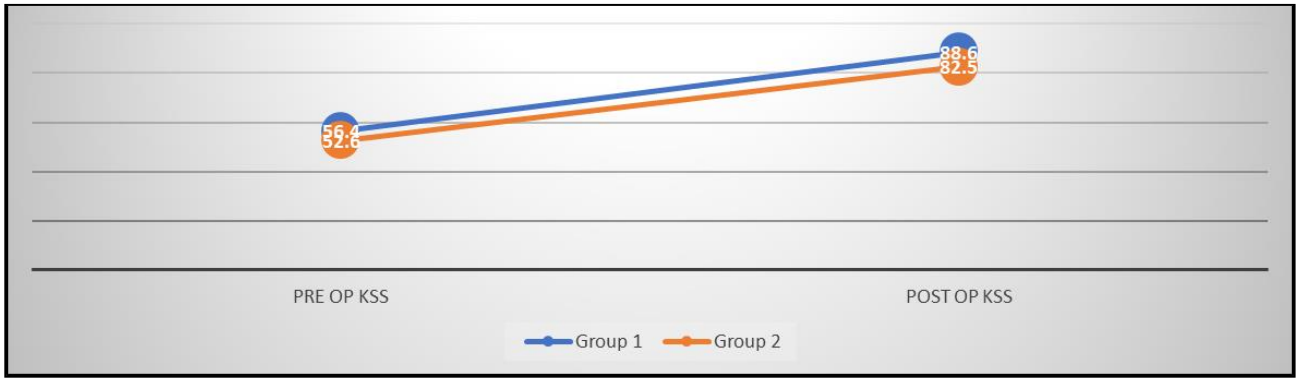

Fig 3: Comparision of Pre and Post op functional scores

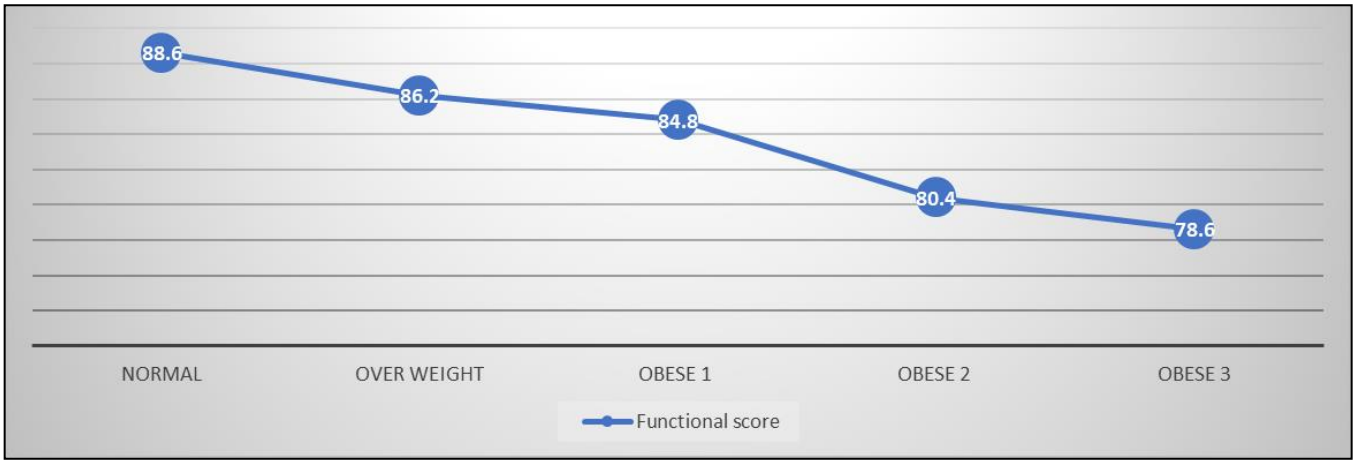

Fig 4: Functional score based on BMI

Complications

- While there were no complications in group 1, there was a single episode of infection for which revision was done subsequently for the patient belonging to class 2 obese group.
- The absolute number of complications were not sufficient to perform any statistical analysis.

Discussion

- Overall, in the study it was revealed that there is no significant difference in post-operative functional outcome in patients with a normal BMI as compared to overweight or obese patients. A sub-group analysis found lower functional outcome scores in class 2 and class 3 obese patients compared to both overweight and class 1 obese patient.
- The study shows that, most of the patients presenting for total knee replacement are either overweight or obese. This finding is also observed in previous studies, which revealed a considerable proportion of patients undergoing total knee arthroplasty are now obese [10].
- A recent study by baker *et al.* [11] using NJR data on 13673 primary TKRs revealed equivalent functional outcome comparing normal weight individuals and the ones with BMI > 25, a similar finding in this study. They found that irrespective of BMI, the improvement of patient reported outcomes (PROMs) were similar.
- Similarly, it was revealed by Desmukh *et al.* [12] that there is no correlation with BMI and functional outcome at 1-year follow-up.
- However, a consensus is yet to be reached, as there is also evidence showing inferior clinical outcomes in increasing BMI particularly more than 40. A review on 445 total knee replacements was done by Collins *et al.* [16] which showed inferior outcome in individuals with a BMI more than 30 on a follow-up of 9 years.
- Interestingly, although over weight and obese patients showed lower outcome scores as compared to non-obese patients, they achieved a significant absolute functional improvement and the authors concluded that "No reason is found to limit access to total knee replacement in obese patients".
- Despite no difference in functional outcome, there was an episode of infection in obese group. Literature showed clear evidence of increased peri-operative complications with increasing BMI in TKA. The etiology behind this is multifactorial. The risk of both superficial and deep peri-prosthetic joint infections is significantly high with increasing BMI. A recent meta-analysis by Kerkhoffs *et al.* [13] on 15276 obese and 5061 non obese patients revealed an odds ratio of 1.9 for all infection and 2.38 for deep infection in obese patients as compared to non-obese patients.
- The risk of thromboembolic phenomenon is also high in obese patients [14]. Counselling the patients in detail about the increased risk of peri-operative complications with increasing BMI is also crucial. While it would seem intuitive that patients should attempt to lose weight before surgery, some recent evidence also suggests that obese patients losing a significant proportion of bodyweight preoperatively, actually have a higher rate of surgical site infection compared to control [15]. The subject of perioperative weight management needs further research.
- It is acknowledged that long term outcome may not correspond to early functional outcome and this subject requires a further research.

Conclusion

In conclusion, overall in our study it is shown that comparing normal weight individuals and those with BMI >25 there is no difference in post-operative functional outcome. Patients should receive a detailed counselling regarding the potential increased risk of complications with increasing BMI, however TKA should not be denied based solely on weight if medically fit to undergo the procedure.

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