International Journal of Research in Orthopaedics
Oropeza-Bonfanti F et al. Int J Res Orthop. 2024 Mar;10(2):260-264
http://www.ijoro.org

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20240405

Original Research Article

Short-term functional outcomes in patients undergoing primary total knee arthroplasty according to their body mass index

Fabiola Oropeza-Bonfanti[1]*, Guillermo Bobadilla-Lescano[1], Felipe Martínez-Escalante[1], Eduardo Vallejo-Gómez[1], Ángel de Jesús Balam-May[2], Felipe Cámara-Arrigunaga[1]

[1]Department of Joint Surgery and Arthroscopy, Hospital de Ortopedia Peninsular, Mérida, Yucatán, México
[2]School of Medicine, University of Yucatán, Yucatán, México

Received: 06 December 2023
Revised: 16 January 2024
Accepted: 31 January 2024

***Correspondence:**
Dr. Fabiola Oropeza-Bonfanti,
E-mail: dra.fabiola.o.bonfanti@hotmail.com

ABSTRACT

Background: The impact of an increased body mass index (BMI) in patients with ostheoarthritis who undergo total knee arthroplasty (TKA) remains a controversial variable in terms of risks and benefits. This study aimed to evaluate the influence of BMI in the functional outcomes of patients with ostheoarthritis who underwent TKA.
Methods: We followed a cohort of patients who underwent total knee arthroplasty with a primary diagnosis of osteoarthritis. Patients were stratified into 3 groups according to the World Health Organization classification of BMI. We assessed the association between BMI group and functional scores using the Western Ontario and McMaster osteoarthritis index (WOMAC) over the time intervals of pre– and postoperatively at 1 month, 3 months and 1 year.
Results: The difference in means between pre-surgical WOMAC and WOMAC at first follow-up according to each BMI group was divided as follows: normal 10.9 ($p=0.195$), overweight 15.7 ($p\leq0.001$) and obese 20.6 ($p\leq0.001$). Study participants with a higher BMI had worse preoperative WOMAC scores and had greater improvement from baseline to 1 month. After one year of follow-up, participants in all BMI groups had similar WOMAC scores.
Conclusions: Patients with obesity who underwent TKA showed greater functional improvement one month after surgery compared to the other BMI groups. Subsequently, it was observed at the end of the 12-month follow-up that all patients, regardless of BMI, had improved functional outcomes, and the magnitude of improvement was similar in all BMI groups.

Keywords: Body mass index, Total knee arthroplasty, WOMAC, Functional outcomes

INTRODUCTION

Osteoarthritis (OA) is a chronic and progressive degenerative joint pathology that generates significant disability and considerable socioeconomic costs.[1]

The prevalence of osteoarthritis in Mexico is 10.5% (95% CI 10.1 to 10.9), it is more frequent in women (11.7%) than in men (8.7%), although it varies greatly in the different regions of the country.[2] In 2021, the incidence rate of obesity in the state of Yucatan was 476.02 cases per hundred thousand inhabitants (State Government of Yucatan - October 2022), ranking among the highest in the country.[3]

Overgaard, Wang and Bourne found an increased risk of knee OA in overweight and obese patients. In addition, obese patients have an increased likelihood of requiring a total knee arthroplasty (TKA).[4-6] Overgaard et al reported that compared with normal-weight individuals, the relative risk of requiring a TKA was 2.7 (95% CI: 2.5-3.0) higher in overweight individuals and 7.3 (6.7-8.0) higher in obese individuals aged 45-64 years old. Zheng et al found that

with a 5 kg/m^2 increase in body mass the risk of knee OA increases by 35%.[7]

Daigle et.al and Wall et al. reported that TKA is a reliable and cost-effective surgical procedure, which is commonly used to treat end-stage knee osteoarthritis.[8,9] The main objective of this surgery is to improve the quality of life of patients by relieving pain and improving the functionality of the joint.[10,11]

The relationship between body mass index (BMI) and functional outcomes after a TKA has been studied in the literature; however, there is still controversy about its long-term influence.[12-14] In relationship to knee OA, the Western Ontario and McMaster Universities arthritis index (WOMAC) scale is used to assess pain, stiffness, functional status and associated activities.[15]

Maniar et al conducted a study about the influence of BMI on functional outcomes in postoperative TKA patients with obesity, they found that late function was lower in patients with a higher BMI.[15] On the other hand, Baghbani-Naghadehi et al found that, 12 months after a TKA, there was no significant difference in function between the different BMI groups.[13] Araujo et al in their study comparing WOMAC with different patient variables showed that obese and non-obese individuals benefit from TKA with no functional differences after the intervention.[16] Giesinger et al evaluated WOMAC in postoperative TKA patients and their results suggest that obese patients may achieve the greatest benefits from a TKA in terms of function and pain relief one year after surgery.[17]

The aim of this study is to investigate the influence of BMI on functional outcomes as measured by the WOMAC in Mexican population undergoing short-term TKA. The results of this study are expected to provide valuable information on the importance of BMI on functional outcomes after a TKA.

METHODS

A sample of patients, who had undergone TKA during a period of 12 years (between January 2010 and November 2022) was analyzed. The patients were operated in the Orthopeaedics Hospital of the Mexican Red Cross in Merida, Mexico; by three different orthopedic surgeons, with high specialty in joint surgery with more than 10 years of experience. The TKAs were performed by medial parapatellar approach, using the following prostheses (Vanguard™ - Biomet, Anthem™ and Genesis™ II – Smith and Nephew, Rolflex™ - Evolutis). All patients received subarachnoid block.

The inclusion criteria for this study were: patients over 18 years old, undergoing primary total knee arthroplasty, diagnosis of osteoarthritis and those with complete records. Patients with a diagnosis of pre- or post-surgical infection, history of rheumatic disease, history of fracture in the knee submitted to the procedure, unicompartmental prosthesis, prosthesis with cruciate retention, use of revision or constrained components during the procedure and trans-surgical complications such as fracture or ligament injury were excluded.

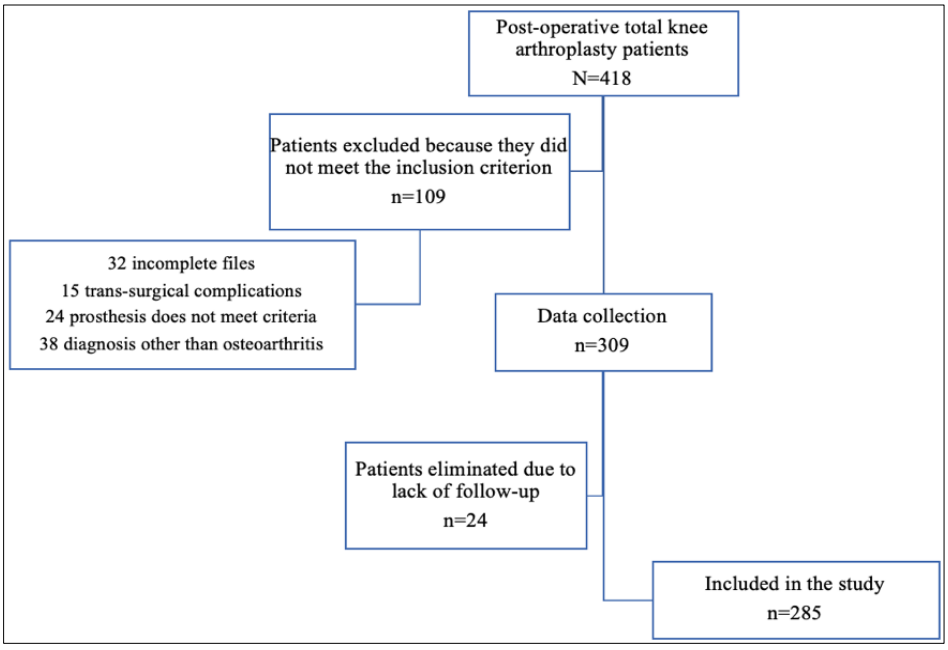

Figure 1: Patient selection.

Patients' body mass index (BMI) was calculated and they were divided into 3 groups, according to World Health Organization (WHO) classification: normal (BMI≤24.99 kg/m^2), overweight (25≤BMI≤29.99 kg/m^2), obese

(BMI≥30 kg/m^2). Patients with BMI below 18.5 kg/m^2 were included in the first group.

Functional outcomes were assessed using the WOMAC rating scale and compared according to patients' BMI. The WOMAC index, developed by Bellamy et al uses a 5-point Likert scale (0=not at all, 1=mild, 2=moderate, 3=severe, 4=extreme) and contains 24 items covering three dimensions: pain (5 items), stiffness (2 items) and function (17 items). A total score combining all three dimensions was used. Scores range from 0 to 20 for pain, 0 to 8 for stiffness, 0 to 68 for physical function, and 0 to 96 for the total aggregate score.[18]

The results are interpreted as follows: score 0 to 30: high quality of life; score 31 to 60: fair quality of life; and, score 61-96: low quality of life. Pre-surgical WOMAC, follow-up 1 (one month after surgery), follow-up 2 (3 months after surgery) and follow-up 3 (12 months after surgery) were measured.

The mean and standard deviation for continuous variables and frequencies for categorical variables were analyzed and calculated means difference with analysis of variance (ANOVA). The change in WOMAC and its change in relation to time and BMI were assessed.

A total of 418 patients who underwent total knee arthroplasty were registered, of which 126 patients were excluded. Of the excluded patients: 32 patients had incomplete records, 15 patients had trans-surgical complications, 24 patients were fitted with a prosthesis other than a primary post-stabilized prosthesis, 38 patients had a diagnosis other than osteoarthrosis and 24 patients were lost to follow-up.

RESULTS

During the period from June 2010 to November 2022, 285 patients underwent total knee arthroplasty with a mean follow-up of 5.9±3.7 years. The mean age was 72±9.5 years. Of which 213 were female (75%) and 72 were male (25%) (Table 1).

Regarding body mass index, a total of 26 patients were found with normal BMI, 70 patients with overweight, 189 patients with obesity. The descriptive analysis of the WOMAC showed a mean pre-surgical total WOMAC of 46, total WOMAC at one month after surgery of 27.6, total WOMAC at 3 months after surgery of 20.9 and at one year after surgery the mean WOMAC was 10.1 (Table 1).

The mean difference between pre-surgical WOMAC and WOMAC at first follow-up according to each BMI group was divided as follows: normal 10.9 (p=0.195), overweight 15.7 (p≤0.001) and obese 20.6 (p≤0.001). The mean difference amid the WOMAC at first follow-up and the WOMAC at second follow-up was: normal 6.94 (p=0.078), overweight 6.390 (p≤0.001) and obese 6.815 (p≤0.001). Finally, the mean difference between the WOMAC at second follow-up and the WOMAC at third follow-up was: normal 9.61 (p=0.008), overweight 11.878 (p≤0.001) and obese 10.546 (p≤0.001).

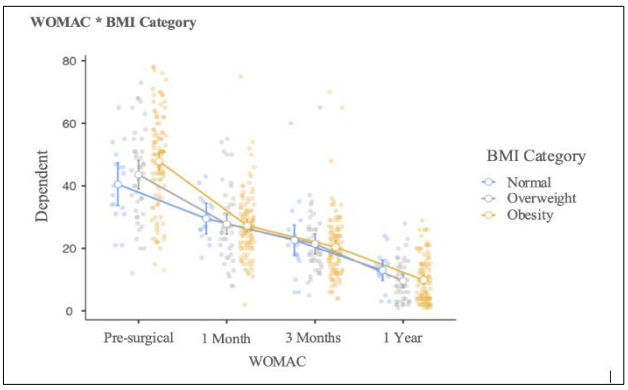

Figure 2: Adjusted mean WOMAC scores by BMI group and time (baseline [preoperative] and 1, 3, 12 months).

Each line represents a BMI group: blue - normal weight (BMI of <25 kg/m^2), gray - overweight (BMI of 25 to 29.9 kg/m^2), yellow - obese (BMI of ≥30 kg/m^2)

When comparisons were made amongst the different BMI groups, the only statistically significant difference was found in the mean difference between the pre-surgical WOMAC and the WOMAC of the first follow-up of the obesity group in contrast to the other two BMI groups. After one year of follow-up, the results were homogenized among the three groups (Figure 2).

Table 1: Demographics of patients having osteoarthritis treated with total knee arthroplasty, stratified according their body mass index.

Demographics	All patients	Norma-l BMI	Overweight	Obese
Total number	285	26	70	189
Age (years)	72±9.5	74±11	74±11.41	71±10.23
Gender				
Male	72	9	24	39
Female	213	17	46	150
WOMAC				
Pre-surgical	46±14.89	38±13.67	44±14.42	47.42±14.79
1 month	27.6±10.35	27±9.27	27±11.61	25±10
3 months	20.9±12.1	19.1±13.5	21.4±12	19.6±11.8
1 year	10.1±6.86	10.5±6.2	9.5±6.4	9.4±1

DISCUSSION

Regarding the relationship between BMI and functional outcomes after a TKA, Wang et al performed a meta-analysis of 20 studies comparing the functional outcomes of 35,897 patients divided according to their BMI, in which all groups had significant improvement in their functional scale after surgery; however, the obese and morbidly obese group had a higher percentage of improvement (pre-surgical versus post-surgical) than the normal BMI group.[19] Similarly, in our study, all groups had a significant improvement in WOMAC, especially the obese group (post-surgical WOMAC compared to pre-surgical WOMAC). On the other hand, Baum et al performed a prospective single-center cohort study to investigate function in postoperative TKA patients, in which all patients had the same rate of improvement regardless of BMI.[20] This is partially similar to the results found in our patients, where: they had the same rate of improvement regardless of BMI at 1-year follow-up; however, at 1-month follow-up the percentage of improvement in the obese group was higher than in the other groups.

Maniar et al conducted a study about the influence of BMI on functional outcomes in postoperative TKA patients with obesity. They reviewed the records of 919 knees (885 patients). The results of the study showed that class I obese (BMI, 30 to 35 kg/m^2) had comparable early and late knee function to non-obese after TKA, while class II obese (BMI, 35 to 40 kg/m^2) had comparable early function, but reduced late knee function compared to non-obese patients.[15] However, in our study, late function in patients with obesity was found to be comparable to non-obese patients. Giesinger et al made a retrospective analysis of 1565 patients who underwent TKA and evaluated their change in WOMAC scores between preoperative and 12-month follow-up amongst the different BMI groups.[17] They found that patients with class I-II obesity showed larger improvement on the WOMAC function and total score at one-year follow-up. In our study, the results at one-year follow-up showed to be uniform between the different BMI groups.

Collins et al. made a prospective study following 445 primary TKA at 6 and 18 months, and 3, 6 and 9 years. They found that patients with higher BMI had greater improvement ($p<0.001$) in pain and function on the comparative pre-surgical WOMAC measurement vs post-surgical at 3-month follow-up compared to the lower BMI groups; however, all groups had similar levels of pain and function at 24 months.[21] This behavior of the results was similar in our study given that from the second follow-up all three BMI groups remain at similar levels of improvement with no significant differences amongst groups. Baghbani-Naghadehi et al conducted a study of 15,151 patients undergoing 12-month postoperative follow-up for TKA. As in our study, their results indicate that at the end of the 12-month follow-up, all patients, regardless of their BMI, had improved in their functional scale and quality of life, and the magnitude of improvement was similar in all BMI groups.[13] Similarly, in the study conducted by Araujo et al analyzed 58 patients comparing different variables (age, gender, BMI and the type of angular deformity of the knee) to their WOMAC scores and observed that obese individuals benefit from TKA with no functional differences after the intervention compared to non-obese patients.[16] Kerkhoffs et al in their prospective 10-year follow-up study found that BMI had no significant impact on functional outcomes after TKA.[22] This could not be corroborated in the present study given the 12-month follow-up. Among the limitations of the study, we can state that it is a case series with a small number of participants in the normal BMI group, probably because it is a region of the country with a high rate of obesity, which resulted in the group of patients with obesity being disproportionately larger compared to the other groups. The follow-up of the patients is limited to one year; it is necessary to follow the series for a longer period of time.

Some authors mention that the analysis of categorical data should be done under the Rasch model; however, in this study the conventional WOMAC scale was used to evaluate the functional improvement of the patients.[23] Data on complications in postoperative TKA patients according to BMI are needed to adequately assess the risk-benefit of TKA in patients with obesity.

CONCLUSION

In our population with obesity who underwent postoperative post-stabilized cemented total knee arthroplasty showed greater functional improvement one month after surgery compared to the improvement in WOMAC of overweight or normal BMI patients. Subsequently, it was observed that at the end of the 12-month follow-up all patients, regardless of BMI, had improved functional outcomes, and the magnitude of improvement was similar in all BMI groups. It would be advisable to increase the follow-up period in further investigations to improve the assessment of the functional outcomes in TKA patients with an increased BMI.

ACKNOWLEDGEMENTS

Authors would like to thank PhD and MD Ramon Esperon-Hernandez (Professor at University of Yucatan) for his advice in this paper writing.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Glyn-Jones S, Palmer AJR, Agricola R, Price AJ, Vincent TL, Weinans H, et al. Osteoarthritis. Lancet. 2015;386(9991):376-87.
2. Peláez-Ballestas I, Sanin LH, Moreno-Montoya J, Alvarez-Nemegyei J, Burgos-Vargas R, Garza-

Elizondo M, et al. Epidemiology of the rheumatic diseases in Mexico. A study of 5 regions based on the COPCORD methodology. J Rheumatol. 2011;38(86):3-6.
3. Gobierno del Estado de Yucatán. Diario Oficial del Gobierno del Estado de Yucatán. Agenda 2040 Unidos Para Seguir Transformando Yucatán. 2022. Available at: https://agenda2040.yucatan.gob.mx/. Accessed on 18 September 2023.
4. Wang Y, Wluka AE, Simpson JA, Giles GG, Graves SE, de Steiger RN, et al. Body weight at early and middle adulthood, weight gain and persistent overweight from early adulthood are predictors of the risk of total knee and hip replacement for osteoarthritis. Rheumatol (United Kingdom). 2013;52(6):1033-41.
5. Bourne R, Mukhi S, Zhu N, Keresteci M, Marin M. Role of obesity on the risk for total hip or knee arthroplasty. Clin Orthop Relat Res. 2007;465(465):185-8.
6. Overgaard A, Frederiksen P, Kristensen LE, Robertsson O, W-Dahl A. The implications of an aging population and increased obesity for knee arthroplasty rates in Sweden: a register-based study. Acta Orthop. 2020;91(6):738-42.
7. Zheng H, Chen C. Body mass index and risk of knee osteoarthritis: Systematic review and meta-analysis of prospective studies. BMJ Open. 2015;5(12).
8. Daigle ME, Weinstein A m., Katz JN, Losina E. The cost-effectiveness of total joint arthroplasty: a systematic review of published literature Meghan. Pract Res Clin Rheumatol. 2012;26(5):649-58.
9. Wall C, Johnson T, de Steiger R. Symptom management for patients awaiting joint replacement surgery. Aust J Gen Pract. 2020;49(7):444-6.
10. Bachmeier CJM, March LM, Cross MJ, Lapsley HM, Tribe KL, Courtenay BG, et al. A comparison of outcomes in osteoarthritis patients undergoing total hip and knee replacement surgery. J Osteoarthr Res Soc Int. 2001;9(2):137-46.
11. Chesworth BM, Mahomed NN, Bourne RB, Davis AM. Willingness to go through surgery again validated the WOMAC clinically important difference from THR/TKR surgery. J Clin Epidemiol. 2008;61(9):907-18.
12. Baum G, Jacobs H, Lazovic D, Maus U, Hoffmann F, Seeber GH. The influence of obesity on functional outcomes and patient satisfaction 8 weeks after total knee arthroplasty: results of the prospective FInGK study. BMC Musculoskelet Disord. 2022;23(1):1-9.
13. Baghbani-Naghadehi F, Armijo-Olivo S, Prado CM, Gramlich L, Woodhouse LJ. Does obesity affect patient-reported outcomes following total knee arthroplasty? BMC Musculoskelet Disord. 2022;23(1):1-9.
14. Wall CJ, Vertullo CJ, Kondalsamy-Chennakesavan S, Lorimer MF, De Steiger RN. A Prospective, Longitudinal Study of the Influence of Obesity on Total Knee Arthroplasty Revision Rate: Results from the Australian Orthopaedic Association National Joint Replacement Registry. J Bone Jt Surg. 2022;104(15):1386-92.
15. Maniar RN, Maniar PR, Singhi T, Gangaraju BK. WHO class of obesity influences functional recovery post-TKA. CiOS Clin Orthop Surg. 2018;10(1):26-32.
16. Araujo HRDS, Heyn RS, Torres MR, Paranhos H, da Silva UC, Oliveira EC. Clinical and Functional Analysis After Total Knee Arthroplasty. Acta Ortop Bras. 2022;30(3):e247855.
17. Giesinger K, Giesinger JM, Hamilton DF, Rechsteiner J, Ladurner A. Higher body mass index is associated with larger postoperative improvement in patient-reported outcomes following total knee arthroplasty. BMC Musculoskelet Disord. 2021;22(1):635.
18. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J SL. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol. 1988;15(12):1833-40.
19. Wang H, Qiong M, Ma B. Analysis of the influence of BMI on the outcome after total knee arthroplasty. Int J Surg Glob Heal. 2021;4(3):e55.
20. Baum G, Jacobs H, Lazovic D, Maus U, Hoffmann F, Seeber GH. The influence of obesity on functional outcomes and patient satisfaction 8 weeks after total knee arthroplasty: results of the prospective FInGK study. BMC Musculoskelet Disord. 2022;23(1):1-9.
21. Collins JE, Donnell-Fink LA, Yang HY, Usiskin IM, Lape EC, Wright J, et al. Effect of Obesity on Pain and Functional Recovery following Total Knee Arthroplasty. J Bone Jt Surg - Am. 2017;99(21):1812-8.
22. Kerkhoffs GMMJ, Servien E, Dunn W, Dahm D, Bramer JAM, Haverkamp D. The Influence of Obesity on the Complication Rate and Outcome of Total Knee Arthroplasty. J Bne Jt Surg. 2012;3(4):343-9.
23. Leung YY, Thumboo J, Yeo SJ, Wylde V, Tannant A. Validation and interval scale transformation of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in patients undergoing knee arthroplasty, using the Rasch model. Osteoarthr Cartil Open. 2022;4(4):100322.

Cite this article as: Oropeza-Bonfanti F, Bobadilla-Lescano G, Martínez-Escalante F, Vallejo-Gómez E, Balam-May AJ, Cámara-Arrigunaga F. Short-term functional outcomes in patients undergoing primary total knee arthroplasty according to their body mass index. Int J Res Orthop 2024;10:260-4.