



# Patients lose weight after a total knee arthroplasty: myth or reality?

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## Abstract

**Background** Obesity is one of most discussed factors when assessing prosthetic knee surgery outcomes. Prior to the procedure, most patients perceive that their excessive weight is secondary to the low level of activity due to limiting knee pain.

**Objectives** The main objective of this study was to assess whether patients undergoing total knee arthroplasty (TKA) lose weight after the procedure. The secondary objective was to correlate weight loss with post-operative knee function.

**Methods** A prospective observational study was designed including 247 patients who undergone TKA from January 2018 to January 2019. A significant change in weight was considered anything above or below 5% of the pre-operative weight. Three groups were established based on a change in weight: loss of more than 5%, those who did not pass above or below 5% of their initial weight and increase of more than 5%. Follow-up was carried out at 12 months after the intervention assessing patient's BMI (kg/m<sup>2</sup>), functional level (KSS), weight loss expectations, and range of motion.

**Results** Among the total population, 17 (6.9%) lost weight, 168 (68%) did not have a change, and 62 (25.1%) increased weight at one year follow-up. The mean pre-operative BMI was 31.5 kg/m<sup>2</sup>, and mean postoperative BMI was 31.98 kg/m<sup>2</sup>. Furthermore, obese patients were more likely to present weight reduction than non-obese ( $p=0.01$ ). When comparing functional results between groups, no differences were observed in terms of KSS-K and KSS-F.

**Conclusion** Patients who undergo TKA do not lose weight one year after surgery. When correlating weight loss with post-operative outcomes, no differences were observed between groups.

**Keywords** Obesity · Weight · TKA · Outcomes · Expectations

## Introduction

Obesity, defined as a body mass index of  $> 30$  kg/m<sup>2</sup>, is becoming a problem of epidemic proportion in industrialized world and countries with emerging economies. It is a documented risk factor for osteoarthritis, which leads to a curtailment of physical activity and a decline in the quality of life of patients [1]. The worldwide incidence is expected to rise with an increase in the incidence of hip and knee osteoarthritis [2].

Total knee arthroplasty (TKA) is a common procedure used in the management of knee osteoarthritis with documented satisfaction rates of 90% in patients [3]. In the context of TKA, obesity is a documented risk factor for post-operative morbidity, increasing the rates of surgical site infections and readmission rates as well as decreasing implant longevity [4–6].

The prevalence of obesity in patients who undergo TKA is estimated to be as high as 55%, with 82% of all patients who undergo this procedure having a BMI  $> 25$  [7]. In the literature, how obesity affects the functional outcome of this procedure remains unclear. Some data points to better functional outcomes in non-obese patients and other studies report similar improvements in functional levels [8, 9]. On the other hand, there is a consensus that obese patients have lower survival rates and increased intra-operative and post-operative complications than the non-obese [10].

Weight reduction is recommended as part of the treatment of knee osteoarthritis in obese patients, but patients

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attribute excessive weight prior to the surgery to a lower level of activity due to limiting knee pain. Most of them expect to be able to return to normal physical activity, without joint dysfunction, and normal body mass index values after the surgery.

The main purpose of this study was to assess whether patients who undergo TKA lose weight at the 12-month follow-up. It was hypothesized that patients tended to maintain the same weight or gain weight after TKA. The secondary objective was to correlate weight loss with post-operative knee function as measured with the KSS function and knee scores as well as ROM.

## Material and methods

A prospective descriptive study was conducted with patients who had undergone a primary TKA, from January 2018 until January 2019, in the same and were operated upon by the same surgical team (5 surgeons).

The inclusion criteria was patients with diagnosis of knee osteoarthritis who had undergone primary TKA. The exclusion criteria included any cognitive disorder that might limit comprehension and, thereby, the ability to score as well as the ability to modify their lifestyle. Patients with incomplete weight, height, or score data were also excluded. Patients who underwent contralateral primary TKA during the follow-up period were also excluded.

TKA was performed with a parapatellar medial approach with cemented fixation of implants and patellar resurfacing in all cases. The same antibiotic prophylaxis was given (cefazolin or vancomycin, in case of an allergy to penicillin), and the same standard rehabilitation protocol was applied to all patients.

Patients were weighed, and their heights were measured pre-operatively and at 12 months after surgery. The same electronic scale (Exacta Premium, Sohenle, Germany) was used to weigh all the patients, using the metric system (kilograms) at the follow-up. Based on previous studies, we considered a significant weight loss as a change of 5% with reference to the pre-operative value [4, 11]. Depending on weight, patients were divided into three groups. Patients who lost more than 5% of their original weight were assigned to group 1. Group 2 consisted of those who saw no significant weight change (original weight  $\pm$  5%), and those patients who gained more than 5% of their initial weight made up to group 3.

Pre-operatively, patients were assessed for range of motion (ROM), with the Knee Society Knee (KSS-K) and Function (KSS-F) scores, the Visual Analog Score (VAS) for pain, and their expectation of weight loss after the procedure (dichotomous variable, yes–no) also factored in. Patients were also assessed at 12 months post-operatively for ROM,

the KSS-K and KSS-F, the VAS, and the fulfilled weight loss expectations (yes/no). The KSS is a clinical score that is divided into knee and functional rating categories. Each category has a maximum score of 100 points. The knee rating is based on pain, range-of-motion, and stability and alignment. The functional score is based on the distance the patient can walk without stopping, the ability to go up and down stairs, and whether an assistive device is needed. The validated version of the KSS was used [12].

All patients gave an informed consent prior to participating in this investigation. Furthermore, approval was obtained from the institutional review board before beginning the investigation (CEIm-2017/7170/I).

## Statistical analysis

Descriptive statistics were used to summarize the demographics, quality of life, and knee function. Quantitative variables were described through mean and standard deviation. Qualitative variables were described through frequencies table (number and percentage). Differences among weight groups were checked through Chi-square test for categorical variables and one-way ANOVA analysis for quantitative variables. Statistical analysis was performed using STATA 15.1. The results were considered statistically significant at  $p$  value  $< 0.05$ .

## Results

Data from 247 patients with a TKA was finally included in this study, 68 (27.5%) men and 179 (72.5%) women. The mean age was 73.4 (SD 6.3) years. At the end of follow-up, 17 (6.9%) patients lost weight, 168 (68%) did not show a change in weight, and 62 (25.1%) gained weight. No differences were observed in the pre-operative demographic values (Table 1).

Mean pre-operative body mass index (BMI) was 31.5 kg/m<sup>2</sup>. As shown in Table 2, 18 (7.3%) patients had normal weight (BMI 20–25), 85 (34.4%) were overweight (BMI 25–30), and 144 (58.3%) were obese (BMI  $> 30$ ).

In the post-operative period, a mean increase of 0.48 kg/m<sup>2</sup> in the BMI was seen, obtaining a mean BMI of 31.98 kg/m<sup>2</sup>, with 16 (6.5%) patients having normal weight, 93 (37.7%) being overweight, and 138 (55.9%) classifying as obese.

It was observed that non-obese patients lose weight less frequently than obese patients ( $p = 0.013$ ). In terms of weight gain, no differences were observed between the obese and non-obese. As described in Table 3, pre-operative weight loss expectation did not correspond to greater post-operative weight loss. There was a similar

**Table 1** Demographic characteristics of groups

	Weight reduction ( <i>n</i> = 17)	Weight maintenance ( <i>n</i> = 168)	Weight gain ( <i>n</i> = 62)	<i>p</i> Value
Age (years)	75.7 ± 0.46	73.6 ± 6.2	72.1 ± 6.8	n.s
Gender (M/F)	6/11	43/125	19/43	n.s
Side of surgery (L/R)	6/11	88/80	30/32	n.s
Mean ROM	108.3 ± 9.3	104.7 ± 11.5	106.2 ± 10.2	n.s
Mean BMI pre	32.9 ± 3.3	31.8 ± 4.0	29.4 ± 3.2	n.s
Mean BMI post	29.9 ± 3.1	32.1 ± 4.0	32.2 ± 3.5	n.s

*M* male, *F* female, *L* left, *R* right, *ROM* range of motion, *BMI* body mass index

**Table 2** Weight changes after TKA depending on preoperative obesity

	Weight reduction ( <i>n</i> = 17)	Weight maintenance ( <i>n</i> = 168)	Weight gain ( <i>n</i> = 62)
No obesity ( <i>n</i> = 103)	4	68	31
Obesity ( <i>n</i> = 144)	17	98	29
<i>p</i> Value	0.013	n.s	n.s

distribution of changes in weight between patients who expected to lose weight after the procedure and those who did not.

**Table 3** Weight changes after TKA depending on preoperative weight loss expectancies

	Weight reduction ( <i>n</i> = 17)	Weight maintenance ( <i>n</i> = 168)	Weight gain ( <i>n</i> = 62)	<i>p</i> Value
Expectation of weight loss ( <i>n</i> = 72)	7 (9%)	45 (63%)	20 (28%)	n.s
No expectation of weight loss ( <i>n</i> = 155)	12 (8%)	110 (71%)	33 (22%)	n.s

No differences were observed in terms of ROM between groups in the pre-operative or the post-operative time. The weight lost group presented pre-operative knee ROM of 108.3° (± 9.3°). For the weight-maintained group, it stood at 104.7° (± 11.5°) and at 106.1° (± 10.2°) for the weight gain group. On the other hand, weight lost group had a post-operative ROM of 108.2° (± 9.4°), the same weight group had 111.9° (± 7.8°), and weight gain group had ± 112.5° (± 8.9°).

As shown in Fig. 1, the mean KSS values were similar between groups when comparing the functional results. At pre-operative measuring, all the groups obtained similar KSS-F (*p* = 0.32) and KSS-K values (*p* = 0.29). At 1 year after the surgery, similar results in KSS-F (*p* = 0.69) and KSS-K were achieved (*p* = 0.45), obtaining an increase in function comparable between groups in both subscales: KSS-F (*p* = 0.23) and KSS-K (*p* = 0.69).

## Discussion

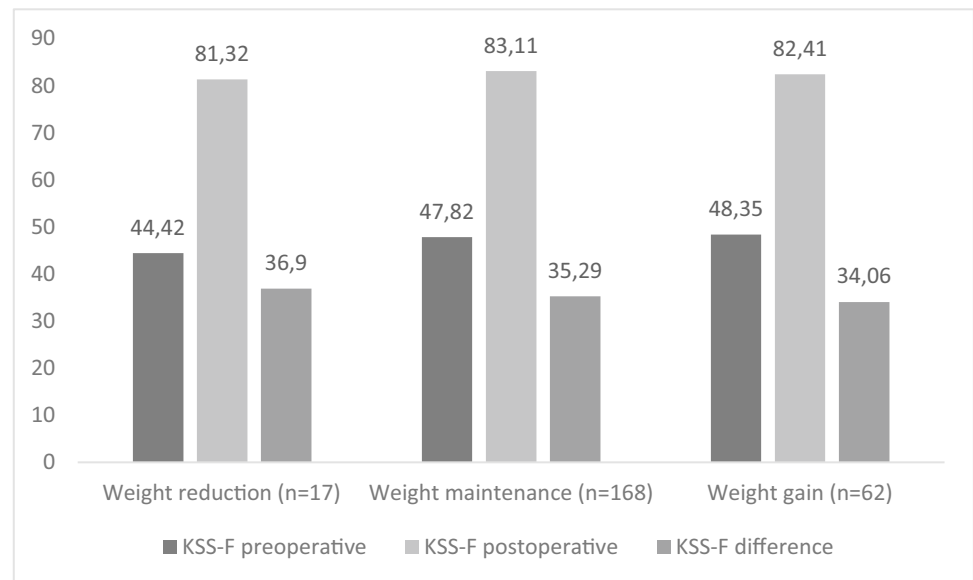
The main finding of this study is that most of patients who undergo TKA do not have significant weight loss at one year after the procedure. In the present study, 31.7% of the patients declare that one of the expectations of the TKA surgery is to lose weight, but only 6.9% of the patients have lost weight at 12 months after surgery. In fact, 25.1% of patients saw an increase in their weight. A similar trend was previously described by Riddle et al. in which 22.1% of patients who had undergone TKA presented an increase of > 5% in their weight at one year after the procedure [7]. In addition, only 7% of patients in this study had significant weight

loss, a percentage that is inferior to the 37.9% reported by Teichtal et al. and to the 11.9% reported by Duchman et al. [13, 14]. The results presented in this article are similar to the ones presented by Chen et al. in which 14% of patients had a reduction in their BMI, 65% maintained their BMI, and 21% had an increased BMI at 2 years after surgery [15]. Although TKA patients present a significant improvement in functional scores such as KSS and Oxford Knee Scale after the procedure, meaning they increase their ability to carry out daily activities, weight loss may be affected by biological, behavioral, and environmental factors that cannot be controlled or changed with a single surgical procedure like TKA, and therefore, despite that some are able to regain their previous functional level, it may not be reflected in effective weight loss in the post-operative period [4, 16].

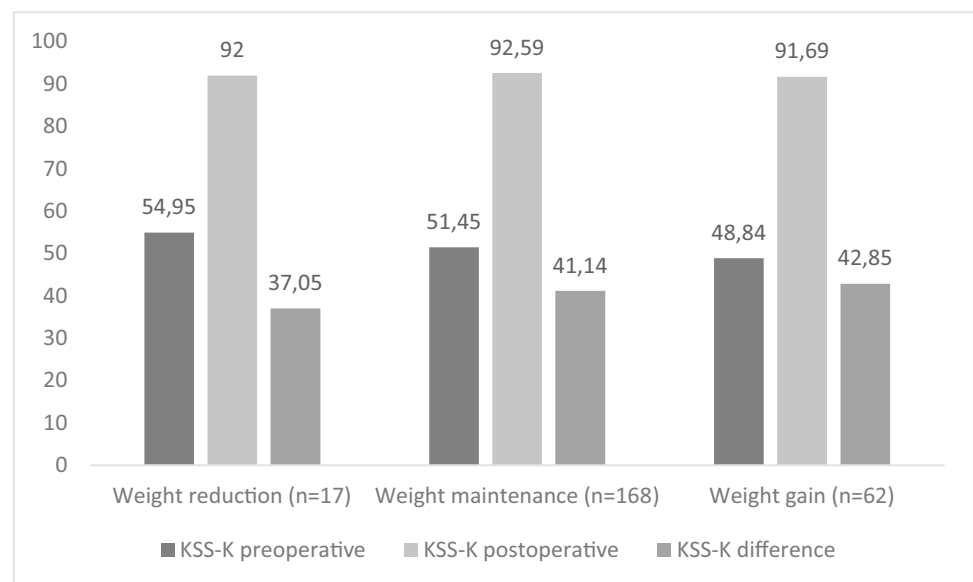
Obese patients presented greater weight loss than the non-obese, with 11.8% of the patients presenting with > 5%

**Fig. 1** Similar KSS levels were found between the three groups, both in KSS-F (left) and KSS-K (right)

#### Left side: KSS-F scores



#### Right side: KSS-K scores



weight loss, in contrast to the 3.7% in the non-obesity group. Moreover, when comparing changes in the BMI, obese patients showed a minor increase ( $0.52 \text{ kg/m}^2$ ) when compared to the non-obese population ( $0.95 \text{ m/kg}^2$ ). This finding is in line with those reported by Stets et al. in which patients with a BMI  $> 30 \text{ kg/m}^2$  showed a trend towards weight loss after TKA [17]. Chen et al. also reported that the morbidly obese (BMI  $> 40 \text{ mg/m}^2$ ) tended to lose more weight at two years after the procedure [18]. Although obese patients were more likely to have weight loss, the tendency still was

to maintain or increase weight rather than lose it. It was observed that 98 (68.1%) of the obese patients maintained and 29 (20.1%) increased their weight.

It would be reasonable to think that patients who have a pre-operative weight loss expectation would be more likely to lose weight one year after the procedure. However, no differences were observed in weight change relative to pre-operative expectations with there being similar results among the groups in this study. Before TKA, less than 10% of the patients lose weight because of self-reported

mobility issues despite medical recommendations. Post-operatively, as previously commented, most patients tend to maintain or gain weight instead of losing it [13, 14, 19, 20]. Pellegrini et al. reported that weight loss programs should start prior to surgery and be maintained at least for at six months after the procedure, with the focus being on diet, exercise, and periodic motivational interviews [21]. In this study, no pre-operative or post-operative motivational interventions were carried out. It may have contributed to the patient's failure to lose weight despite being personally invested in it before the procedure.

Findings of previous studies suggest that obesity is associated with lower functional results, less satisfaction, and increased pain following TKA [2, 18, 22, 23]. Additionally, a higher BMI is associated with worse values on the Oxford Knee Scale and in the EuroQol-5 Dimensions at baseline and persisting at one, five and ten years after TKA [24, 25]. Nonetheless, scarce data is reported on whether a significant change in weight after surgery leads to an improvement in functional levels. According to our study, no difference was observed between weight-change groups in terms of the KSS values, meaning that similar functional levels are achieved at 12 months after the procedure. However, these are short-term functional levels, and long-term results may be better able to determine whether distinct readings can be seen within each group. Several studies report that differences in functional results in TKA tend to be increased at two years post-operatively [11, 26].

The results presented in this study reinforce the idea that patients significantly increase their functionality, which restores their ability to perform basic activities of daily living without pain. However, this increase in the functional level is not accompanied by weight loss even when patients expect to lose it before surgery. Therefore, behavioral changes must be adopted and put into action by individual patients.

This study has different limitations to be considered when interpreting the results. The follow-up of patients in this study was of 12 months. It is a short-term period in which functional levels were not different between groups. As previously stated, longer-term periods may expand differences in terms of functionality and changes in weight in patients who have undergone TKA [26]. Another limitation of this study is that no weight loss programs were adopted prior to or after the procedure, which may have been a contributing factor in them not losing weight. Weight loss protocols are not used systematically in our daily practice, and this may limit the ability of patients to achieve the preoperative expectation of weight loss. In addition, sports activity and eating habits were not assessed prior to and post-surgery to consider whether patients who try to lose weight make a behavioural change to achieve their expectations.

According to this study, most of the patients who underwent TKA did not achieve significant weight loss at one year after the procedure even when function had dramatically improved, independently of the pre-operative weight loss expectations.

**Author contribution** Conceptualization: A.C., J.L-B, P.H., and J.C.M. Methodology: J.L.B., R.T-C., P.H., and J.C.M. Formal analysis: A.C. and J.L-B. Investigation: A.C., J.L-B., J.S-S., R.T-C., P.H., and J.C.M. Draft preparation: A.C.L. Writing-review and editing: J.L-B., P.H., and J.C.M. All authors read and approved the final manuscript.

**Data availability** The authors confirm that the data supporting the findings of the study are available within the article.

## Declarations

**Ethics approval** The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of the hospital (CEIm-2017/7170/I).

**Informed consent** Informed consent was obtained from all subjects involved in the study.

**Competing interests** The authors declare no competing interests.

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