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Current Evidence Does Not Support the Use of Tibial Stem Extension in Total Knee Arthroplasty of Obese Patients: A Systematic Review

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ABSTRACT

Background: Obesity rates have been increasing globally, leading to a higher incidence of knee osteoarthritis and a surge in primary and revision total knee arthroplasty (TKA). The debate continues on the impact of obesity on TKA success, particularly regarding the use of stemmed tibial components in obese patients. This systematic review aimed to compare the effectiveness of stemmed tibial components versus standard keeled tibial components in obese patients undergoing TKA.

Methods: A systematic review was conducted using databases including PubMed, Embase, Scopus, and Web of Science from inception to December 2023. The eligibility criteria were Participants: Patients who have obesity undergoing TKA; Intervention: stemmed TKA; Comparator: standard keeled tibial TKA; Outcomes: aseptic loosening, patient-reported outcome measures (PROMs), and overall revision. Data extraction and quality assessment were performed using the Newcastle-Ottawa Scale for cohort studies and the Cochrane risk-of-bias tool for randomized trials.

Results: The search yielded 470 studies, with 10 studies (42,533 knees) meeting the inclusion criteria. These studies included 3 randomized controlled trials and 7 retrospective cohorts. The primary outcomes measured were aseptic loosening and overall revision rates, while secondary outcomes included PROMs. Results indicated mixed findings, with some studies suggesting improved outcomes with stemmed components in cases of aseptic loosening and mechanical failure, while others showed no significant difference. The PROMs did not show a significant difference between groups post-TKA. The certainty of the evidence was graded as "very low" using the Grading of Recommendations, Assessment, Development, and Evaluations framework.

Conclusions: Current literature does not provide conclusive evidence to support the routine use of stemmed tibial components in TKA for obese patients. The decision to use stem extensions should not solely rely on the patient's obesity status. Further high-quality studies are needed to clarify the role of stemmed components in TKA for this patient population.

Level of Evidence: III.

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Over the last 3 decades, global obesity rates have shown a consistent upward trend [1,2]. Obese individuals face an increased risk of developing knee osteoarthritis, with a rise of 9 to 13% for every additional kilogram of body weight. This risk can escalate by up to 35% for every 5 kilogram weight gain [3]. The growing prevalence of obesity has led to a major surge in primary and revision total knee arthroplasty (TKA) procedures. This trend is expected to continue as more individuals who have obesity-related conditions require TKA [4]. In fact, the percentage of TKA patients who are obese has risen from 31% in 1990 to 60% in 2012 [5,6].

The influence of obesity on the outcome of TKA procedures has been the subject of previous research. Studies have found a connection between obesity and the likelihood of complications and needing revision surgery following TKA, with varying opinions on the body mass index (BMI) threshold associated with this complication [7,8]. Some studies suggest a BMI threshold of > 35 [9,10], while others suggest > 30 [11,12]. Obesity has been found to increase the incidence of all-cause revisions, particularly aseptic loosening of the tibial component, during mid-term and long-term follow-ups [10,13]. The choice of implant, including stem length, may impact functional results and overall quality of life. Ongoing efforts to enhance the survival rates of tibial components in TKAs for obese patients are examining different factors such as keel size, tibial baseplate design, and cement viscosity [14–16]. The use of stem extension has produced differing outcomes, with some studies supporting nonstemmed TKAs [14] and others advocating for using stemmed implants [17].

Recent large-scale studies have indicated that the utilization of stem extension in obese patients may contribute to lowering the occurrence of aseptic loosening over long-term follow-up periods [18,19]. Biomechanical studies have also suggested that using stems may help lessen the risk of aseptic loosening in TKA by reducing micromotion and improving load distribution [4,20]. Nevertheless, using tibial stem extension in obese TKA patients presents several considerations. The cost of the prosthesis associated with a stem extension poses a financial burden [21]. Also, in the event of revision surgery, a previous stem extension may cause more bone loss [22,23]. In addition, stem tip pain may lead to patient dissatisfaction [24].

This systematic review study compared the stemmed tibial component versus the stemless tibial component in obese patients who underwent TKA, focusing on implant failure. It was hypothesized that using stemmed tibial components would yield improved patient-reported outcomes, lower all-cause revision rates, and aseptic loosening.

Methods

We used a predefined protocol for this review, which was registered in the International prospective register of systematic reviews (CRD42024507091). This was a systematic review study prepared based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement [25].

Search Strategy

The electronic databases of PubMed, Embase, Scopus, and Web of Science were systematically reviewed from inception to December 1, 2023 without any limitation on type of study, year of publication, or languages. The tailored search strategy was made specifically for each database by using keywords such as “body mass index,” “obesity,” “stem,” “TKA,” and “total knee arthroplasty.”

Eligibility Criteria

The present study was conducted on double-arm studies and designed to compare stemmed versus nonstemmed tibial TKA, and the Patients, Intervention, Comparator, and Outcomes framework was established: Patients who have obesity undergoing TKA; Intervention: stemmed TKA; Comparator: standard keeled tibial TKA; Outcomes: aseptic loosening, patient-reported outcome measures (PROMs), and overall revision.

Study Selection Items

The data from each database were inputted into EndNote V.20 (Clarivate, Philadelphia, Pennsylvania). There were 2 reviewers (A. S. and M. A. H.) who independently reviewed the studies, starting by eliminating any duplicate articles. The studies were screened in 2 stages: title/abstract screening and full-text assessment. Relevant studies were selected for full-text evaluation based on their titles and abstracts. The studies that met the eligibility criteria were chosen for data extraction and synthesis. A third reviewer (S. M. J. M.) resolved any disagreements between the 2 reviewers. Figure 1 shows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow chart of the study selection process.

Quality Assessment

In this study, the quality of the included cohort studies was rigorously assessed using the Newcastle-Ottawa Scale (NOS). The NOS is a comprehensive tool specifically designed for evaluating the quality of nonrandomized studies, particularly cohort studies. For the randomized controlled trials (RCTs), the Cochrane risk-of-bias tool for randomized trials (RoB 2) was employed.

Data Extraction

There were 2 reviewers (A. S. and M. A. H.) who conducted the data extraction process, and the data items of first author name, year of publication, level of evidence, study period, number of patients (knee), BMI of patients, compared components, mean follow-up duration, and evaluated subjects were extracted into a predesigned Excel sheet (Microsoft, Redmond, Washington). The outcomes of studies were classified based on the evaluated subjects, including PROMs, aseptic loosening, and overall revision.

Data Synthesis

Due to the high heterogeneity of studies, inconsistent outcomes reported in the studies, different arms of studies, and small number of reports, the data synthesis was conducted according to synthesis without meta-analysis in systematic reviews guidelines [26].

Results

Study Characteristics

After conducting a database search, we found 470 studies. We screened the studies by evaluating their titles and abstracts. This led to the identification of 36 papers that we examined further. During the second screening stage, where we assessed the full texts, we excluded 26 more studies. As a result, we selected 10 studies for the final review [15,17,27–34].

In our included studies, 42,533 knees underwent primary TKA. Across them, 1 study analyzed 39,743 knees from an Australian

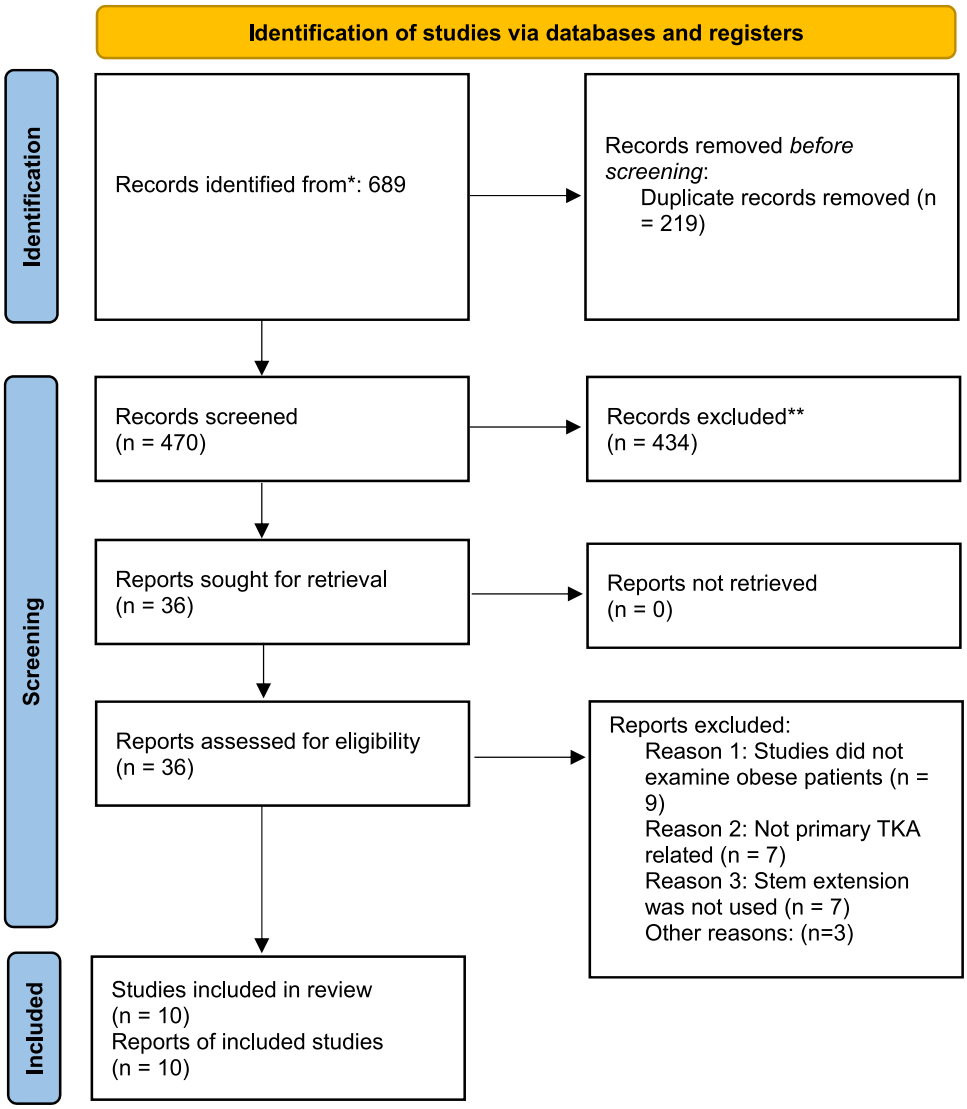

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart of study selection process.

national registry (Table 1). Of the 10 studies reviewed, 3 were RCTs, while the rest were retrospective cohorts. All patients were followed for more than 2 years after surgery to investigate the outcomes of different stems. The studies focused on patients who had obesity (BMI more than 30) and compared clinical or radiological results between standard tibial trays and tibial trays with an intramedullary stem.

Quality Assessment

The 3 RCTs were assessed using the RoB 2 tool (Figure 2). We excluded the study by Elzohairy et al. [31] from our qualitative synthesis due to high bias, as indicated by the overall score of the RoB 2 tool. Furthermore, there appeared to be a discrepancy between the level of evidence stated in their publication and the actual study design. Additionally, their study's reported frequency of patient follow-up raised doubts about its credibility. In 2 other RCTs [17,28], there were concerns regarding the overall RoB 2 score, indicating some concerns in at least one domain for this result. However, there was no high risk of bias for any domain.

The quality assessment of the 7 cohort studies was conducted using the NOS from (Table 2) which evaluate studies based on selection, comparability, and outcome criteria. The studies by Fournier et al. [32], Elcock et al. [29], and Osan et al. [27] demonstrated high methodological quality, each earning 8 of 9 possible stars. Steere et al. [33] also showed good quality with a rating of 7 stars, slightly lacking in comparability. There were 2 studies by Garceau et al. [15,34] that received moderate ratings of 6 stars each, reflecting adequate study designs, but with some limitations in the selection process and comparability. Samy et al. [30] had the lowest rating of 5 stars, primarily due to biased selection criteria.

Outcomes

Revision Rate due to Aseptic Loosening

There were 8 studies, consisting of 2 RCTs and 6 cohort studies, that have provided data on the rate of aseptic loosening [15,17,27–29,32–34]. There were 2 RCTs with follow-up periods ranging from 3 to 6 years that found no significant difference in aseptic loosening rates between the 2 groups [17,28]. The incidence

Table 1
Characteristics of the Studies.

Study	Level of Evidence	Study Date	BMI of 2 Groups	No. of Patients (Knee)	Cemented Status	Compared Components
Parratte et al., 2017[a]	2	2010-2011	NA	120	Cemented	Stemmed (10 mm, 100 mm) versus unstemmed (standard) tibial component
Steere et al., 2018[b]	3	2013-2014	Stemmed: 44.4, Standard: 39.8	178	Cemented	Prophylactic short tibial stem extension (30 mm) versus standard tibial component
Fournier et al., 2020[c]	3	1987-2015	Stemmed group: 34.6, Standard group: 34.6	140	Cemented	Tibial short stem extension (30 mm) versus standard tibial stem
Garceau et al., 2020[d]	3	2012-2017	Stemmed group: 32.9, Standard group: 30.6	236	Cemented	Standard keeled design with and without stem extension (14 × 30 mm)
Elzohairy et al., 2021[e]	2	2010-2020	Stemmed group: 38.84, Standard group: 40.0	200	Cemented	Stemmed cemented tibial tray with the cementless press-fit stem versus unstemmed cemented tibial tray
Samy et al., 2022[f]	3	2008-2017	Stemmed group: 31.7, Standard group: 28.8	191	Cemented	Standard tibial tray versus tibial tray with an intramedullary stem (75 to 100 mm)
Garceau et al., 2022[g]	3	2014-2019	Stemmed group: 31.3, Standard group: 31.1	1,350	Cemented	Standard keeled design with and without stem extension (14 × 30mm)
Elcock et al., 2023[h]	3	2013-2018	Standard group: 42.5, Stemmed group: 43.4	111	Cemented	Standard keeled (SK) versus universal base plate (UBP) with stem
Mohammad et al., 2023[i]	2	2013-2020	Stemmed group: 35.56, Standard group: 35.15	264	Cemented	Standard keeled tibial part versus long-stemmed tibial part (100 mm)
Osan et al., 2023[j]	3	1999-2021	Stemmed group: 37.5, Standard group: 36.2	39,743	Cemented	Tibial implant augmentation with a stem versus no stem

BMI, body mass index.

[a] Parratte S, Ollivier M, Lunebourg A, Verdier N, Argenson JN. Do Stemmed Tibial Components in Total Knee Arthroplasty Improve Outcomes in Patients With Obesity? Clin Orthop Relat Res. 2017;475(1):137-45.

[b] Steere JT, Sobieraj MC, DeFrancesco CJ, Israelite CL, Nelson CL, Kamath AF. Prophylactic Tibial Stem Fixation in the Obese: Comparative Early Results in Primary Total Knee Arthroplasty. Knee Surg Relat Res. 2018;30(3):227-33.

[c] Fournier G, Yener C, Gaillard R, Kenney R, Lustig S, Servien E. Increased survival rate in extension stemmed TKA in obese patients at minimum 2 y follow-up. Knee Surg Sports Traumatol Arthrosc. 2020;28(12):3919-25.

[d] Garceau SP, Harris NH, Felberbaum DL, Teo GM, Weinblatt AI, Long WJ. Reduced Aseptic Loosening With Fully Cemented Short-Stemmed Tibial Components in Primary Cemented Total Knee Arthroplasty. J Arthroplasty. 2020;35(6):1591-4.e3.

[e] Elzohairy MM, Elaidy SM, Attia ME. A comparative prospective study between stemmed versus an unstemmed tibial component in total knee arthroplasty in obese patients. Eur J Orthop Surg Traumatol. 2021;31(4):695-703.

[f] Samy AM, Azzam W. Tibial Tray with a Stem: Does It Have Any Role in Primary Cemented Total Knee Replacement? J Knee Surg. 2022;35(1):15-20.

[g] Garceau SP, Pivec R, Teo G, Chisari E, Enns PA, Weinblatt AI, et al. Increased Rates of Tibial Aseptic Loosening in Primary Cemented Total Knee Arthroplasty With a Short Native Tibial Stem Design. J Am Acad Orthop Surg. 2022;30(7):e640-e8.

[h] Elcock KL, MacDonald DJ, Clement ND, Scott CEH. Total knee arthroplasty in patients with severe obesity: outcomes of standard keeled tibial components versus stemmed universal base plates. Knee Surg Relat Res. 2023;35(1):9.

[i] Mohammad MM, Elesh MM, El D, Il. Stemmed versus Nonstemmed Tibia in Primary Total Knee Arthroplasty: A Similar Pattern of Aseptic Tibial Loosening in Obese Patients with Moderate Varus. 5-Year Outcomes of a Randomized Controlled Trial. J Knee Surg. 2023;36(12):1266-72.

[j] Osan JK, Harris IA, Harries D, Peng Y, Yates PJ, Jones CW. Stemmed Tibial Fixation for Primary Total Knee Arthroplasty in Obese Patients-A National Registry Study. J Arthroplasty. 2023.

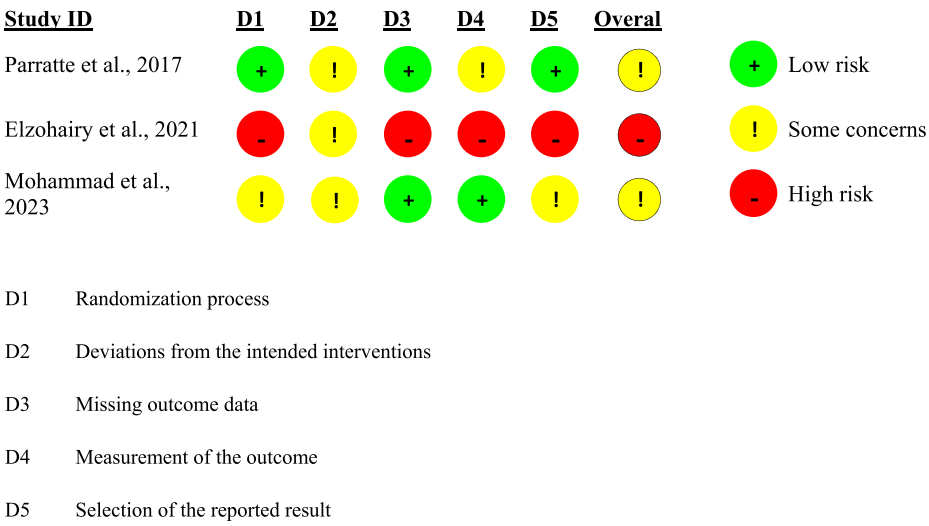

Fig. 2. Quality assessment of included randomized controlled trials (RCTs).

Table 2
Quality Assessment of the Retrospective Cohort Studies.[a]

Study	Selection	Comparability	Outcome	Overall Star Rating
Steere et al., 2018	****	*	**	7
Fournier et al., 2020	****	**	**	8
Garceau et al., 2020	***	*	**	6
Samy et al., 2022	**	*	**	5
Garceau et al., 2022	***	*	**	6
Elcock et al., 2023	****	*	***	8
Osan et al., 2023	****	**	**	8

[a] Each * shows a score in Newcastle-Ottawa Scale.

of aseptic loosening and the *P*-value comparison between the 2 groups are presented in Table 3.

There have been mixed findings from retrospective cohort studies. An Australian National Registry study conducted by Osan et al. [27] examined more than 39,000 TKAs in obese patients over an average follow-up period of 2.5 years. The study revealed no significant difference in the revision rate due to aseptic loosening when comparing stemmed components to standard ones. Steere et al. [33] reported that no patients in either group required revision surgery for aseptic loosening during a mean follow-up period of 32 months. However, the mean follow-up duration was significantly longer in the standard group, by approximately 4 months. Additionally, the mean BMI was significantly higher in the stemmed group (44.4 versus 39.8). Elcock et al. [29] identified only one case of aseptic loosening in the standard group over a mean follow-up period of 4.9 years. Their study exclusively included patients who had a BMI of ≥40.

In contrast, 3 other cohorts produced controversial findings. They reported that using a stemmed tibial component may lead to better outcomes in cases of aseptic loosening [15,32,34]. Fournier et al. conducted a matched cohort study [32], with a mean follow-up time of more than 50 months for each group. They found that using a tibial stem in obese patients reduced the failure rate significantly. Garceau et al. conducted 2 separate retrospective cohort studies [15,34] and observed that the incidence of tibial aseptic loosening was greater in the standard group. However, they did not indicate whether these differences were statistically significant. Furthermore, in both studies, they compared the Kaplan-Meier survival rates of patients who had a BMI more than 40 and had either stemmed or nonstemmed implants. The results from both studies were consistent and indicated higher tibial implant survival rates in the stemmed group. While the Kaplan-Meier survival rate was significantly higher in the smaller study [15], it was not significant in the more extensive study [34].

Overall Revision Rate

There were 6 studies that provided data on the revision rates attributable to any cause [17,27–29,32,33] (Table 3). The most common reasons for revision were infection, instability, exchange of the patella component, and revision of the insert component. There were 5 of these studies that reported no significant difference between the stemmed and standard tibial components [17,28,29,32,33]. However, interestingly, Osan et al. [27] found that obese patients who had a stem extension had a higher overall revision rate, which was primary due to instability in the stemmed TKAs.

Patient-Reported Outcome Measures

Studies used multiple PROMs to evaluate the patient's knee function and pain before and after surgery (Table 3). The PROMs employed in the studies include subjective and objective Knee Society Scoring (KSS), Knee Society functional scores, Knee Injury and Osteoarthritis Outcome Score, visual analog scale pain score, 12-item Short Form Survey score, the EuroQol 5-dimension score, and the Oxford Knee Score. The tool most commonly used was the

Table 3
Findings of the Studies on Revision Rate.

Study	Mean Follow-Up (Y)	Revision Rate due to Aseptic Loosening			Revision Rate due to Any Reason		
		Stemmed Group	Standard Group	Significance of Difference	Stemmed Group	Standard Group	Significance of Difference
Parratte et al., 2017	3	0 of 60	1 of 60 (1.7%)	NS (Not specified *P* value)	1 of 60 (1.7%)	1 of 60 (1.7%)	NS (Not specified *P* value)
Steere et al., 2018	2.7	0 of 50	0 of 128	NS (Not specified *P* value)	4 of 50 (8%)	2 of 128 (1.6%)	NS (Not specified *P* value)
Fournier et al., 2020	4.3	0 of 35	7 of 105 (6.7%)	Higher in standard group ($P < 0.001$)	0 of 35	2 of 105 (1.9%)	NS (Not specified *P* value)
Garceau et al., 2020	> 3	0 of 162	4 of 72 (5.5%)	NS (Not specified *P* value) KM for 4 y: higher in stemmed group ($P = 0.008$)	-	-	-
Garceau et al., 2022	> 2	0 of 500	12 of 850 (1.4%)	NS (Not specified *P* value) KM for 5 y: higher in stemmed group ($P = 0.349$)	-	-	-
Elcock et al., 2023	4.9	0 of 54	1 of 57 (1.7%)	NS (Not specified *P* value) KM for 5 y: higher in stemmed group ($P = 0.391$)	Not available	Not available	NS (Not specified *P* value) KM for 5 y: higher in standard group ($P = 0.475$)
Mohammad et al., 2023	6.1	0 of 130	0 of 134	NS (Not specified *P* value)	-	-	-
Osan et al., 2023	3.1	No reported data on the exact number of cases	No reported data on the exact number of cases	NS ($P = 0.892$)	No reported data on the exact number of cases	No reported data on the exact number of cases	NS (Not specified *P* value)

NS, not significant difference between groups; KM, Kaplan-Meier survival analysis.

KSS. It was employed in 5 studies to assess the function of patients' knees and their pain [17,28,30–32].

Both of the RCTs that we reviewed measured PROMs and reported no significant differences in PROMs between groups after TKA [17,28]. There were 3 of the 7 retrospective studies that measured PROMs preoperatively and postoperatively for both groups. Samy et al. reported significantly better outcomes in obese and severely obese patients who had a stemmed tibial tray [30]. The KSS and Knee Society functional scores were significantly better in the stemmed group for patients who have a BMI more than 30 [30]. The other 2 studies found no differences between the groups [29,32].

Certainty Assessment

Due to the considerable heterogeneity observed among the included studies, a meta-analytical synthesis was precluded. Consequently, we adopted the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework, which facilitates a systematic assessment based on the certainty of the evidence [35]. Using GRADE methodology, it was concluded that the certainty associated with the use of stemmed tibial components in primary TKA for obese patients is "very low" for all outcomes (Table 4).

Discussion

This study offers a comprehensive review of the impact of stemmed tibial components in TKA for patients who gave obesity, a group often at a higher risk of complications postsurgery. In biomechanical studies, the use of stems has been proposed as a method to reduce the risk of aseptic loosening in TKA [20]. However, our study reveals that the justification for using stems specifically for this purpose remains unclear. The evidence indicating a direct correlation between stem usage and reduced aseptic loosening is not sufficiently robust. Most of the established evidence in this regard has a low level of evidence with a high level of bias. The reported results in the literature are not consistent with each other. Even if stems were found to be effective, their impact on obese patients is likely minimal, with a very low level of certainty according to the GRADE framework in reducing aseptic loosening and overall revision. Despite the significance of TKA in obese patients, the current literature does not support the routine use of stem extensions in TKA, particularly considering the increased costs associated with this method.

In a systematic review of 917,447 obese patients and 2,188,834 nonobese patients, it was found that obese patients face higher overall revision rates (odds ratio [OR] = 1.15), complications (OR = 1.21), infections (OR = 1.47), and readmissions (OR = 1.21) [36]. Another systematic review examining aseptic loosening rates found no significant difference between obese and nonobese patients [37]. However, a study by Abdel et al. involving 5,088 well-aligned TKAs reported that obese patients have a 2-fold (hazard ratio = 1.9) greater risk of aseptic loosening [38]. Additionally, a cohort study of 588 patients indicated that the incidence of aseptic loosening increased with a higher BMI [39]. It appears that both aseptic loosening and overall revision rates are elevated in obese patients, and this trend is not mitigated by the use of stem extensions, according to our study.

The results in the current literature are inconsistent. Studies reporting lower aseptic revision rates in stemmed tibial base plates had small sample sizes. Studies with larger sample sizes did not report lower aseptic revision rates in stemmed tibial baseplates. There was a high risk of bias in the studies reporting better outcomes with stems due to the retrospective nature of those studies and low sample sizes. Interestingly, in the study by Osan et al., it was reported that with the use of stem baseplates, the risk of overall revision is increased [27]. Another limitation to the inherent designs of the studies is that the risk of aseptic revisions is low, and the use of tibial stems might not reduce the risk of aseptic loosening significantly.

There were 2 other comprehensive national registry studies that examined the role of stem extension in primary TKA cases without any limitation on the BMI of their patients [18,19]. The first study, conducted in the United States, involved an extensive review of 20,952 TKA procedures, while the second study, carried out in Australia, encompassed an even larger cohort of 133,070 TKAs. Both studies arrived at a similar conclusion, indicating that the use of stem extension may contribute to a reduction in the incidence of aseptic loosening over extended periods of follow-up. However, our research presents a nuanced perspective, suggesting that the efficacy of stem extension might be diminished in obese patients, which challenges the prevailing assumptions in this area.

The relationship between obesity and PROMs following TKA is a subject of interest in orthopaedic surgery [40]. Some studies have indicated that obese patients, particularly those undergoing TKA, may initially present with lower PROMs compared to their normal-weight counterparts [41,42]. This difference can be attributed to the increased strain and stress that excess weight places on the knee joint, potentially exacerbating preoperative conditions. Despite this initial disparity, some studies also highlight a significant improvement in PROMs for obese patients compared to the normal-weight population [42–45]. Interestingly, the majority of the studies we reviewed did not observe a significant enhancement in PROMs with the use of tibial stems in these patients.

In terms of surgical complications, it has been observed that obese patients may face a higher risk of short-term complications following TKA [42,45]. These complications are likely due to the challenges involved in operating on and managing postoperative care for individuals who have a higher BMI. However, from a long-term perspective, complications seem to equalize between obese and normal-weight patients [42,45]. Notably, in the majority of the studies we reviewed, the use of tibial stem extension did not significantly alter the rates of complications. An exception to this was noted in the Australian registry study, which reported that obese patients who have stem extensions exhibited higher instability during follow-up [27]. It is important to consider, although, that the findings from this registry study might carry a high degree of bias due to their national nature.

Using a stem in primary TKA increases costs [21]. If the stemmed TKA fails, revision TKA can result in substantial bone loss, making the procedure more complex and challenging [22,23]. The increased costs associated with stemmed TKAs may be a major drawback, especially considering the potential complications and the difficulty of revision surgeries. These financial implications, coupled with the mixed evidence on clinical outcomes, highlight the need for careful consideration when deciding on the use of stems in obese patients undergoing primary TKA.

Another critical aspect of our research involved examining the relationship between BMI and the risk of postsurgical complications. The debate over the precise BMI threshold at which the risk escalates is ongoing and complex [42,46–48]. Our included studies mirror this debate, highlighting the lack of consensus in the medical community. The inconsistencies in these findings underscore the need for a standardized approach to evaluating the role of BMI.

Potential Limitations

The primary limitation of our study lies in the existing body of literature. We encountered considerable heterogeneity among the

Table 4
Certainty Assessment.

Certainty Assessment							Impact	Certainty	Importance
No. of Studies	Study Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations			
Revision rate due to aseptic loosening (follow-up: range 2 y to 6 y; assessed with: Clinical)									
9	Nonrandomized studies	Serious	Serious	Not serious	Serious	All plausible residual confounding would reduce the demonstrated effect	Half of the 8 studies, with 1,726 patients having a BMI more than 30, supported using stemmed tibial components. The other 4 studies, with 40,305 patients, did not show a significant difference in outcome between stemmed and nonstemmed tibial components.	⨁◯◯◯ Very low	CRITICAL
Patient-reported outcome measures (follow-up: range 2 y to 7 y; assessed with: Questions)									
5	Nonrandomized studies	Serious	Serious	Not serious	Serious	All plausible residual confounding would reduce the demonstrated effect	Samy et al. found that using a stemmed tibial component resulted in better outcomes, while 4 other studies found no significant difference.	⨁◯◯◯ Very low	CRITICAL
Revision rate due to any reason (follow-up: range 2 y to 7 y; assessed with: Clinical)									
6	Nonrandomized studies	Serious	Serious	Not serious	Serious	All plausible residual confounding would reduce the demonstrated effect	Study by Osan et al. reported using a stemmed tibial component may increase the revision rate. However, 5 other studies found no significant difference.	⨁◯◯◯ Very low	CRITICAL

BMI, body mass index.

studies we included, which was substantial enough to preclude a meta-analysis. We observed variations in several key aspects of the studies, such as the length of the stems used, the design of the studies (including matched and unmatched cohorts, randomized trials, and national registry studies), and the BMI cutoff points. Additionally, the experience level of the surgeons, particularly in national registry studies, varied tremendously, which could influence the outcomes. Another notable limitation of our research is the lack of evaluation of the postsurgical activity levels of participants. Since activity levels can tremendously impact biomechanical pressure and, consequently, the risk of aseptic loosening, this is a major oversight. Other limitations are the type of implant and the length of follow-up. Some primary tibial baseplates have very long keels, making it difficult to isolate their effect in the data. Long-term follow-up is crucial, especially in assessing failure rates in obese patients, and its absence represents a major limitation.

Future studies should aim to provide more high-quality evidence regarding the role of stemmed tibial components in TKA for obese patients. Future studies should find the specific cutoff point for BMI where the complication increases. Additionally, these studies should rigorously account for confounding variables such as the surgeon's expertise, the presence of metabolic syndrome, and the activity levels of patients after surgery. This will ultimately lead to better-informed clinical decisions.

Conclusions

Although the utilization of stemmed components has been postulated to reduce the risk of aseptic loosening in obese patients, our research suggests that conclusive evidence supporting their efficacy is lacking. The impact of stemmed tibial components on improving survival rates of PROMs in obese individuals remains ambiguous. Consequently, based on our review of the current literature, it is not recommended for surgeons to rely solely on the obesity status of a patient when deciding to use stem extensions.

CRediT authorship contribution statement

Mohammad Poursalehian: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Ali Soltani Farsani:** Writing – original draft, Data curation. **Mohammad Amin Habibi:** Writing – original draft, Data curation. **Mohammadreza Razzaghof:** Supervision, Conceptualization. **Maziar Nafisi:** Writing – review & editing. **Mohammad Ayati Firoozabadi:** Supervision, Conceptualization. **Seyed Mohammad Javad Mortazav:** Writing – review & editing, Supervision, Conceptualization.

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