

QUESTION 4: Do underweight patients (body mass index (BMI) < 18.5kg/m²) have a higher risk of surgical site infection/periprosthetic joint infection (SSI/PJI) following orthopaedic procedures? If yes, does increasing the BMI in underweight patients reduce the risk of SSI/PJI?

RECOMMENDATION: Yes. Underweight patients (BMI < 18.5kg/m²) have a higher risk of SSI/PJI following orthopaedic procedures. However, there is no current evidence indicating that an increase in the BMI of an underweight individual has an effect on reducing the risk of SSI/PJI.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 92%, Disagree: 4%, Abstain: 4% (Super Majority, Strong Consensus)

RATIONALE

BMI abnormalities have been associated with worse outcomes in surgical patients. Most studies have focused on comparisons between obese patients and those of normal weight (NW) in finding that higher BMI is associated with a higher incidence of infections [1–6]. Underweight (UW) patients are typically defined as having a BMI of less than 18.5 kg/m² [7]. UW patients make up 2.3% of the United States population and up to 3.66% of patients in European nations [8,9]. In the field of general surgery, UW patients have been shown to have higher complication rates compared to overweight and obese patients [7,10–12]. Similarly, UW total joint arthroplasty (TJA) patients have also been identified as having a higher incidence of infection, transfusion, dislocation, readmission and mortality [1,3,13,14]. No studies have been identified that evaluate the risk reduction when increasing the BMI in these patients.

Saucedo et al. [1] evaluated readmission risk in cohorts of both total knee arthroplasty (TKA) and total hip arthroplasty (THA) patients. Compared to NW patients (defined as BMI 18.5 to 24.9 kg/m² in this study), UW status was a significant risk factor for readmission at 30 and 90 days postoperatively (16.4 and 11.6%, respectively) with postoperative infection being the leading cause for readmission [1]. A separate study evaluating infection risk factors in patients with rheumatoid arthritis showed that UW status also had an increased risk of infection, (odds ratio (OR) 6.0, 95% confidence interval (CI) 1.2 to 30.9, p = 0.033) [13]. Also, a study by Nafiu et al. demonstrated worse TJA outcomes and higher SSI rates in UW minorities [11]. When patients were stratified based on BMI, the study found SSI rates of 3% in the UW group, 1.3% in the NW group, 1.4% in the overweight group, 1.5% in the obese group and 1.7% in severely obese patients, respectively (p < 0.001) [11].

When specifically evaluating TKA, similar results have been found. Manrique et al. compared UW TKA patients to a cohort of NW TKA patients and found that UW individuals had a higher rate of SSI (11.1%) than did NW individuals (0%) (p = 0.01) [15]. UW patients also had an increased risk of SSI (OR: 23.3; 95% CI 1.2 to 466, p = 0.04) compared to NW patients. This study and others utilized the SSI definition specified by the Centers for Disease Control (CDC) criteria [16]. The CDC SSI criteria was used instead of the Musculoskeletal Infection Society (MSIS) and International Consensus Meeting (ICM) definitions for periprosthetic joint infection (PJI) [17] because the MSIS and ICM criteria were not available at the time of publication.

While there is evidence that UW status increases risk of SSI/PJI, there are a few database studies that contradict these findings. Using the New Zealand joint registry, Murgatroyd et al. showed no increased risk of deep infection at a maximum of two-year follow-up [18]. Of the 5,357 patients, 131 were UW (2.4%). However, UW was defined as BMI < 20 kg/m² in this study [18]. All seven reported deep infections occurred in the overweight and obese groups with zero in the UW group at two years [18]. SSI and wound infections were not reported.

Another registry study, utilizing the Clinical Practice Research Datalink of 31,817 patients, found six-month wound infection rates of 1.5% (BMI < 18.5 kg/m²), 2.2% (BMI = 18.5 to 25 kg/m²), 3.0% (BMI = 25 to 30 kg/m²), 3.3% (BMI = 30 to 35 kg/m²) and 3.1% (BMI > 35 kg/m²) respectively, with UW patients having the lowest wound infection rate [19]. Deep infection rates were not reported. In addition, discharge data from the National Inpatient Sample found that UW individuals (BMI < 18.5 kg/m² in this study) had a decreased rate of postoperative infection (OR 0.23, 95% CI 0.09 to 0.61) [20]. Importantly, all three of these studies possessed the limitations inherent to the analysis of large administrative databases (i.e., errors in data collection, incomplete data sets and observer bias) particularly with the diagnoses of postoperative infection, SSI and PJI.

Overall, there is an established association between low BMI and poorer surgical outcomes, specifically infection, in a variety of disciplines, including TJA in orthopaedics [10–12,19–26]. Furthermore, higher transfusion rates were also observed among UW patients after surgical intervention [11,13,15]. Postoperative allogeneic transfusion has been demonstrated to be an independent risk factor for developing SSI and PJI [27]. A lower BMI may be an indirect measure of nutritional status, as lower BMI patients have been shown to have lower levels of albumin, prealbumin, and protein- all of which can be used to evaluate nutritional status [28]. Low BMI patients have decreased reserves and an inability to accurately react to stress secondary to their suppressed immune systems [29]. Low BMI has also been associated with higher morbidity and mortality rates possibly reflecting an altered physiological state [30]. A potential optimization of this status resulting in a BMI increase in UW patients could be beneficial by decreasing their risk of adverse events. Increasing BMI to mitigate SSI and PJI risk in UW individuals is an area for future study.

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