# The Impact of Body Composition on Total Joint Arthroplasty Outcomes

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**INTRODUCTION**: Complications and revision surgeries following total hip and knee arthroplasties incur significantly higher economic costs compared to the primary procedures themselves. As the annual numbers of hip and knee arthroplasties continue to surge, the imperative for surgeons to discern factors linked to elevated complication risks becomes more pronounced. While conventional risk factors for orthopedic surgeries such as smoking, uncontrolled diabetes, and hypertension have been extensively examined, body mass index (BMI) has emerged as a prominent contributor to infection and the necessity for revisions, particularly due to increasing prevalence of obesity within the US population. Recent research has unveiled the limitations of BMI in fully capturing the intricacies of obesity. In response, body composition, a more nuanced parameter swiftly assessed through bioimpedance analysis (BIA), has emerged as a superior predictor of certain surgical risks, including the likelihood of re-operation and infections. BIA offers a spectrum of metrics for the comprehensive assessment of body composition, demonstrating significant promise for enhancing preoperative risk evaluation. However, this tool remains underutilized within the field of orthopedics. This study aims to delve into multiple BIA-derived metrics and investigate their associations among patients who experienced postoperative complications following total hip arthroplasty (THA) or total knee arthroplasty (TKA).

**METHODS**: This study received approval from the institutional review board. We collected clinical data and conducted BIA on a cohort of 454 patients who had undergone either primary TKA (236 patients) or THA (218 patients). The clinical data encompassed patient demographic characteristics, preoperative assessments (including BMI and comorbidities), preoperative laboratory results, and primary total joint arthroplasty (TJA) outcomes. These outcomes included emergency department visits, incidents of deep joint infection, impaired surgical wound healing, hardware loosening, dislocation, and need for revision surgery. Patients underwent BIA data collection using an InBody scanner at some point during their treatment. To assess significant correlations, we employed T-tests and Chi-square goodness-of-fit tests, with statistical significance set at $p < 0.05$.

**RESULTS SECTION**: Among the 454 patients who underwent TJA, 51 patients experienced post-operative complications; 23 deep joint postoperative infections, 12 with postoperative instability, 8 with hardware loosening, and 8 with dislocation. 34 of these cases received revision surgery. Analysis of pre-operative laboratory results revealed significant differences between the complication and non-complication groups. The complication group had lower albumin levels (4.23 g/dL vs. 4.38 g/dL, p=0.002) and higher hemoglobin A1c levels (7.22 g/dL vs. 6.63 g/dL, p=0.00001) compared to the non-complication group. In terms of bioimpedance analysis (BIA) data, the complication group exhibited a higher mean weight compared to its counterpart in the non-complication group (104.8 kg vs. 94.45 kg, p=0.04). However, there was no significant difference in mean BMI between the two groups (33.55 $kg/m^2$ vs. 35.17 $kg/m^2$, p=0.13). Extracellular water to total body water ratio (ECW/TBW) was found to be significantly higher in the complication group (0.408 vs. 0.394, p<0.001). Furthermore, skeletal muscle indices were higher in the complication group (8.85 $kg/m^2$ vs. 8.34 $kg/m^2$, p=0.02), while the 51 kHz whole-body phase angle (φ) was significantly lower (4.54 vs. 4.8, p=0.04). Among all recorded comorbidities, diabetes was notably more prevalent in the complication group compared to the non-complication group (37% vs. 17%, p=0.007). Other comorbidities such as hypertension (HTN), chronic kidney disease (CKD), immunocompromised status, and current smoking status did not show statistically significant differences between the two groups.

**DISCUSSION**: In our study, we observed significant differences in body composition between those who experienced post-operative complications and those who did not. Pre-operative laboratory analysis revealed lower albumin and higher hemoglobin A1c levels in the complication group, indicating potential nutritional and glycemic factors at play. Importantly, bioimpedance analysis demonstrated differences in extracellular water to total body water ratio and phase angle, highlighting the importance of body water distribution and cellular health and integrity on complication rates. These findings underscore the need for comprehensive pre-operative assessments, personalized care, and diabetes management to optimize outcomes in joint arthroplasty. However, the inherent limitations of a retrospective, single-center design necessitate cautious extrapolation of our findings to diverse patient cohorts and healthcare settings. Moreover, unmeasured variables, such as patient activity levels and other specific comorbidities, might introduce residual confounding, highlighting the importance of comprehensive prospective investigations to validate and refine our observed associations.

**SIGNIFICANCE/CLINICAL RELEVANCE**: Lymphedema is a known risk factor for complications following TJA, however it is difficult to quantify. This study highlights the significance of markers of body water distribution estimated through BIA, such as ECW/TBW and phase angle, as additional variables in assessing complication risk alongside traditional preoperative factors (low albumin, poorly controlled diabetes, and body weight). These findings can assist surgeons in better informing patients about complication risks, refining patient selection criteria, and potentially reducing complication rates in primary arthroplasty, particularly in cases where obesity may not be accurately assessed by BMI alone.

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**Table 1:** Comparative Analysis of BIA Metrics between Complication and Non-complication Groups Post Total Joint Arthroplasty

| | Complication | | |
|---|---|---|---|
| | **No (n=403)** | **Yes (n=51)** | **P value** |
| Percent body fat (%) | 39.39 (9.49) | 39.28 (10.48) | 0.94 |
| Skeletal muscle mass (kg) | 31.98 (8.21) | 34.2 (8.82) | 0.07 |
| Skeletal muscle indices ($kg/m^2$) | 8.34 (1.51) | 8.85 (1.71) | **0.03*** |
| Phase angle (degrees) | 4.8 (0.85) | 4.54 (0.86) | **0.04*** |
| Body fat mass (kg) | 39.19 (15.74) | 42.28 (16.67) | 0.19 |
| Weight (kg) | 97.52 (24.0) | 104.78 (25.9) | **0.04*** |
| BMI ($kg/m^2$) | 33.6 (7.16) | 35.2 (8.11) | 0.13 |
| Extracellular water to total body water (ECW/TBW) | 0.394 (0.01) | 0.408 (0.01) | **<0.001*** |