Optimizing the Relationship Between Height, Weight and Sex to Predict Early Prosthetic Joint Infection in Total Knee Arthroplasty

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INTRODUCTION:

Elevated body mass index (BMI) is associated with increased complications following total knee arthroplasty (TKA). Of particular concern is the association between elevated BMI and prosthetic joint infection (PJI). Given that BMI is a readily available objective metric, patients are often screened for eligibility of TKA using BMI. However, BMI is merely a mathematical transformation of height and weight and was not developed to risk-stratify patients undergoing TKA. Therefore, we hypothesized that we could develop a formula that optimizes the predictive value of height, weight, and sex to outperform BMI as a predictor of early PJI.

METHODS:

Patients undergoing primary TKA between 2010 and 2020 with complete morphological data in the National Surgical Quality Improvement Program database were included. BMI was calculated using the standard formula (kg/m^2) and receiver operating characteristic (ROC) curves were used to assess the discriminative capability of each metric as a predictor of PJI in the first 30 postoperative days. A formula for optimized, sex-adjusted BMI (OS-BMI) was generated using multivariable logistic regression modeling with robust estimates of variance after bootstrapping 50 repetitions. The area under the curve (AUC) of BMI alone was compared to OS-BMI. A Bonferroni-adjusted $p < 0.05$ was considered a statistically significant difference between AUCs.

RESULTS:

Included in our analysis were 385,923 patients (238,328 [62%] female) with an average age 67 ± 9.4 years and average BMI 33 ± 6.8 kg/m^2. Within 30 days postoperatively, 1,249 (0.32%) patients sustained a PJI. As a stand-alone predictor of early PJI, BMI had an AUC of 0.59. The formula for OS-BMI was determined to be: (–1.053339 x height) + (0.0172103 x weight) + (0.324479 x gender) – 5.763274 with an AUC of 0.61 ($p < 0.0001$).

DISCUSSION AND CONCLUSION:

The OS-BMI formula outperforms BMI as a stand-alone predictor of early PJI among patients undergoing primary TKA. Given that nearly all patients with a recorded BMI will have the ability for OS-BMI to be calculated without further testing, this model provides a better screening tool than conventionally used BMI. Further studies should externally validate our model in other registries and determine screening thresholds for primary TKA eligibility.