Socioeconomic Disadvantage Does Not Modify the Impact of Preoperative Opioid Use and Psychiatric History on Stiffness After Primary Total Knee Arthroplasty

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Disclosures: None

Introduction: Preoperative opioid use and psychiatric comorbidities have been associated with increases in various complications following total knee arthroplasty (TKA), while socioeconomic disadvantage and rurality are increasingly recognized as predictors of adverse TKA outcomes. Whether these social determinants modify the impact of opioids or psychiatric history on stiffness requiring manipulation under anesthesia (MUA) remains unknown. We aimed to evaluate the modifying effects of the Area Deprivation Index (ADI) and rural–urban commuting area (RUCA) codes on these associations. Our hypothesis was that non-urban patients and patients in more disadvantaged ADI terciles would experience greater risk of MUA than less disadvantaged and urban patients.

Methods: Following institutional review board approval, a single-center retrospective chart review of 400 primary TKAs performed between 2017 and 2019 was completed. Patients with unicompartmental procedures, revisions, implant removals, less than 90 days of follow-up, and improperly coded ADI or RUCA scores were excluded. Exposures were preoperative opioid use within 3 months of surgery and psychiatric disorder. The latter was identified by any prior diagnosis of anxiety, mood, or psychotic disorder. Effect modifiers were ADI tercile (1–3) and RUCA category (urban vs non-urban). The primary outcome was MUA within 16 weeks. Secondary outcomes included unplanned emergency department, urgent care, or orthopedic clinic visits, infection, revision, and periprosthetic fracture. Risk ratios (RRs) and confidence intervals (CIs) were estimated with modified Poisson regression adjusting for demographics and comorbidities. Multiplicative interaction was tested with exposure × modifier terms, and additive interaction assessed with relative excess risk due to interaction (RERI), attributable proportion due to interaction (AP), and synergy index (S). Sensitivity analyses used urban-only models and dichotomized ADI (T3 vs T1–2).

Results: Among 243 primary TKAs (mean age 65.3 ± 9.4 years; BMI 34.7 ± 6.0; 66.7% female), 14 (5.8%) underwent MUA within 16 weeks. Preoperative opioid use (32.9%) and psychiatric history (27.6%) were not associated with increased MUA risk overall (opioids RR 0.82, 95% CI 0.26–2.52; psychiatric history RR 0.72, 95% CI 0.21–2.49). Adjusted, stratum-specific RRs within urban patients were imprecise and centered near the null (opioids RR 0.90, 95% CI 0.30–2.67; psychiatric history RR 1.57, 95% CI 0.28-8.78). Sparse events in non-urban patients (n = 18; 0 MUAs) precluded stable tests of interaction, and additive metrics (RERI, AP, S) were not interpretable.

Discussion: In this cohort, we found no evidence that opioid use or psychiatric history increased early postoperative stiffness, nor that their effects were modified by neighborhood disadvantage or rurality. While limited by sparse events, particularly among non-urban patients, these results suggest that patient-specific clinical factors may outweigh environmental modifiers in influencing early stiffness. Larger, more heterogeneous samples are needed to evaluate interaction on both multiplicative and additive scales.

Significance/Clinical Relevance: Understanding how socioeconomic disadvantage and rurality modify the relationship between preoperative opioid use, psychiatric comorbidities, and adverse outcomes after total knee arthroplasty addresses a critical barrier in health equity research. This study establishes a framework for examining interaction between individual and social determinants, guiding future work toward targeted preoperative optimization and resource allocation for vulnerable populations.