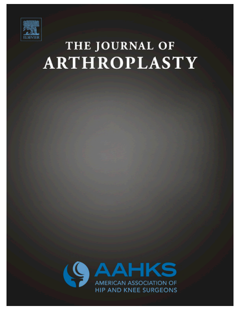

Comorbidities Affect the Racial Disparities in the Incidence of Periprosthetic Joint Infection after Total Knee Arthroplasty

Daisuke Furukawa, MD MS, C. William Pike, MD, Gavin Hui, MD, Jeremy Coyle, PhD, Derek F. Amanatullah, MD PhD

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Daisuke Furukawa MD MS[a], C. William Pike MD[b], Gavin Hui MD[b], Jeremy Coyle PhD[b], Derek F. Amanatullah MD PhD[c]

[a]Division of Infectious Diseases and Geographic Medicine, Department of Medicine, Stanford University School of Medicine, Stanford, CA, USA

[b]Atropos Health, New York, NY, USA

[c]Department of Orthopaedic Surgery, Stanford Hospital and Clinics, Redwood City, CA, USA

Corresponding author:
Daisuke Furukawa, MD MS
Division of Infectious Diseases and Geographic Medicine, Department of Medicine, Stanford University School of Medicine, Stanford, CA, USA
Email: dfuruk@stanford.edu

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Daisuke Furukawa: conceptualization, methodoogy, formal analysis, writing-original draft, writing- review & editing. C. William Pike: methodology, formal analysis, resources, visualization, writing- review & editing. Gavin Huy: methodology, formal analysis, resources, visualization, writing- review & editing. Jeremy Coyle: methodology, formal analysis, software, resources, visualization, writing- review & editing. Derek F. Amanatullah: methodology, formal analysis, writing- review & editing, supervision

Comorbidities Affect the Racial Disparities in the Incidence of Periprosthetic Joint Infection after Total Knee Arthroplasty

Abstract

Background Racial disparity exists in arthroplasty-related outcomes. However, there is little known about racial disparity in the incidence and management of periprosthetic joint infections (PJI). This study aimed to evaluate racial differences in the incidence of PJI after total knee arthroplasty (TKA) and in the incidence of above-knee amputation (AKA) after PJI.

Methods Patients who had a PJI were identified using International Classification of Diseases, 10th edition, and Current Procedural Terminology codes from a national database. The primary outcomes were incidence of PJI and incidence of AKA after PJI stratified by race. There were 175,205 patients who underwent a TKA and were included in the cohort, of which 152,270 (86.9%) were non-Hispanic White, 4,259 (2.4%) were Hispanic, 10,712 (6.1%) were non-Hispanic Black, and 7,964 (4.5%) were non-Hispanic Other. High-dimensional propensity score-matched analysis of non-Hispanic White patients was used to evaluate the effect of race on PJI and AKA incidence, controlling for confounding factors with alpha error set to 5%.

Results Compared to non-Hispanic White patients, non-Hispanic Black patients had a higher incidence of PJI after TKA (hazard ratio [HR] 1.29, 95% confidence interval [CI] 1.18 to 1.42, $P < 0.001$) in the unadjusted model, but there was no difference in incidence after propensity score matching (HR 1.11, CI 0.97 to 1.27, $P = 0.119$). There were no differences in incidence of PJI for non-Hispanic Other (HR 1.08, CI 0.92 to 1.28, $P = 0.350$) and Hispanic patients (HR 0.99, CI 0.80 to 1.24, $P = 0.950$) after propensity score matching. In the subgroup of patients who had a PJI, there was no difference in the incidence of AKA across race, but men were associated with a higher incidence of AKA (HR 1.09, CI 1.09 to 3.43, P = 0.023) after propensity score matching.

Conclusions Racial disparity exists in the incidence of PJI. However, this observed difference was lost after propensity score matching, suggesting that comorbidities drive the observed difference, not race as an independent factor.

Key words*:* racial disparity, prosthetic joint infections, above-knee amputation

Introduction

Total joint arthroplasty is an increasingly common procedure performed nationwide, estimated to reach over four million cases annually in the United States by the year 2030.[1] Periprosthetic joint infection (PJI) is the most common complication following arthroplasties and is associated with major morbidity, mortality, and cost.[2,3] Treatment of PJI is complex, requiring a combination of surgery and prolonged antibiotic therapy.[4] Though infrequent, in some instances, catastrophic salvage measures such as an above-knee amputation (AKA) are used to control PJI after total knee arthroplasty (TKA). There was one study that reported that the incidence of AKAs resulting from PJI tripled from 1998 to 2013[5], a notable trend since AKA is associated with major functional limitation and mortality.[6–8]

There are established racial disparities in arthroplasty-related outcomes. Black patients are at increased risk of adverse outcomes such as readmissions, revision surgeries, and even mortality.[9–12] Despite national efforts to combat these disparities, a study by Amen et al. reported persistent or worsening racial disparities in arthroplasty care and outcomes.[13] For example, the White-Black disparity in rates of complication after total knee arthroplasty (TKA) increased from 1.0 to 2.1% between 2006 and 2015.

Despite an abundance of evidence demonstrating racial disparities in overall arthroplasty outcomes, there is little known about racial disparity in PJI. Past studies usually report aggregate complications, including non-infectious complications such as myocardial infarctions and deep vein thrombosis, and fail to include relevant infectious complications, such as deep surgical site infection.[9–12] Given the high morbidity associated with PJI and the increasing incidence of PJI as a cause of AKA, it is essential to understand if racial disparities exist specifically with PJI. We hypothesized that racial disparities would exist in the incidence of PJI and in the incidence of AKA used to control PJI after TKA.

Materials and Methods

Data source

The data used in this analysis come from the Apollo Dataset from the Atropos Evidence Network (New York, New York, United States), which aggregates information on 66 million patients and 120 health systems nationwide, including longitudinal electronic health records and closed claims data.[14] The database includes data from inpatient, outpatient, emergency department, office/clinic visits, urgent care, and telehealth encounters. In accordance with the Health Insurance Portability and Accountability Act of 1996 (HIPAA) regulatory framework, the dataset was evaluated by a third party for statistical disclosure risk analysis, resulting in an Expert Determination as specified in 45 CFR § 164.514(b)(1). This process ensures that the dataset maintains a sufficiently low level of disclosure risk to comply with HIPAA regulations. The source data for this analysis can be made available upon request to the authors and with written approval from the source data vendors. Institutional Review Board review was not required, as publicly available deidentified data was used for analysis.

Patient selection and outcomes definition

We defined a cohort of individuals, aged 18 to 90, who had undergone TKA and who had no prior history of PJI. Current Procedural Terminology (CPT) and International Classification of Diseases (ICD) 9th and 10th edition codes were used to identify a history of TKA and PJI (Supplemental Table 1). Patients were grouped into four racial/ethnic groups: non-Hispanic White, Hispanic, non-Hispanic Black, and non-Hispanic Other. Patient data from 2010 through April 2024 were used for analysis.

Our primary outcome was effects of race on incidence of new PJI and AKA; the procedure and diagnosis codes used are defined in Supplementary Table 1. A new incidence of PJI was defined as a new entry of a diagnosis code specific to PJI. For the analysis evaluating new incidences of AKA after PJI, the PJI cohort was defined as those having a PJI diagnosis code in addition to an associated surgical procedure code to manage PJI. Comorbidities that are known risk factors for PJI [15,16] were selected *a priori* for additional analysis to determine if these variables were associated with higher incidences of PJI and AKA.

Demographics

There were 175,205 patients included in the cohort, of which 152,270 (86.9%) were non-Hispanic White, 4,259 (2.4%) were Hispanic, 10,712 (6.1%) were non-Hispanic Black, and 7,964 (4.5%) were non-Hispanic Other. The mean follow-up for each group was 1,748.7 ± 981.8 days for non-Hispanic White patients, 1,685.1 ± 1,036.9 days for Hispanic patients, 1,742.4 ± 1,019.3 days for non-Hispanic Black patients, and 1,640.6 ± 959.6 days for non-Hispanic Other patients. Baseline comorbidities were overall balanced among the cohorts. Notable exceptions included: higher proportion of women in the non-Hispanic Black cohort, younger age of Hispanic and non-Hispanic Black cohorts, and higher body mass index (BMI) for non-Hispanic Black and non-Hispanic Other cohorts. A PJI was seen in 5,608 (3.68%) patients in the non-Hispanic White, 163 (3.83%) in the Hispanic, 505 (4.71%) in the non-Hispanic Black, and 287 (3.60%) in the non-Hispanic Other cohort (Table 1).

Subgroup analysis identified 1,434 patients who had PJI who were surgically managed, of which 1,225 (85.4%) were non-Hispanic White patients, 112 (7.8%) were non-Hispanic Black patients, 33 (2.3%) were Hispanic patients, and 64 (4.5%) were non-Hispanic Other patients. The mean follow-up for each group were 1,589.9 ± 860.2 days for non-Hispanic White patients, 1,690.1 ± 821.0 days for Hispanic patients, 1,428.0 ± 847.4 days for non-Hispanic Black patients, and 1,414.8 ± 753.0 days for non-Hispanic Other patients. The non-Hispanic Black cohort was younger, had a higher proportion of women, and had a higher proportion of patients who had chronic pulmonary disease, rheumatic disease, and human immunodeficiency virus (HIV). An AKA was seen in 57 (4.65%) patients in the non-

Hispanic White, 1 (3.03%) in the Hispanic, 7 (6.25%) in the non-Hispanic Black, and 1 (1.56%) in the non-Hispanic Other cohort (Table 2).

Data analyses

In addition to unadjusted analyses, we compared two types of matching for effect estimation: basic matching (matching only on age and sex) and high-dimensional propensity score (hdPS) matching. For hdPS, we fit propensity score models using lasso regression with 5-fold cross-validation, then matched treated and control groups 1:1 based on the propensity scores with a caliper of 0.25 standard deviation and a distance tolerance of 0.01.[17,18] We used patient demographics, diagnosis, procedure, and prescription codes prior to the index date to define covariates of interest. Covariates included age, sex, comorbid illnesses, concurrent prescriptions, and healthcare utilization measures (log-transformed counts of encounters, CPT codes, ICD 9/10 codes, and prescriptions). We included the comorbid illnesses that define the Charlson Comorbidity Index (CCI), as implemented by Quan et al. [19]

Descriptive statistics were reported as means and standard deviations (SD) for continuous variables and as frequencies and proportions for categorical variables. Hazard ratios (HRs) with 95% confidence intervals (CIs) were computed via Cox proportional hazards and reported in the unadjusted, basic-matched, and hdPS-matched datasets. A two-sided *P*-value of 0.05 denoted statistical significance. The number needed to expose was calculated for one additional person to be harmed (NNEH) using the HR and the unexposed event rate at two years post-index date.[20] The NNEH is analogous to the number needed to harm with adjustment for confounding variables, making it a more appropriate measure in observational studies. All analyses were performed using R (v4.2.1, R Core Team 2022, Vienna, Austria) using the Atropos Health real-world evidence platform.

Results

Racial differences in incidence of PJI after TKA

Compared to non-Hispanic White patients, non-Hispanic Black patients had a higher incidence of developing a PJI after arthroplasty (hazard ratio [HR] 1.29, 95% confidence interval [CI] 1.18 to 1.42, $P < 0.001$) in the unadjusted model. The incidence remained significantly higher after basic matching (HR 1.21, CI 1.05 to 1.39, $P < 0.008$), but there was no difference in incidence after propensity score matching (HR 1.11, CI 0.97 to 1.27, $P = 0.119$, Figures 1a to c) between the two groups. There was no difference in the incidence of PJI for non-Hispanic Other patients compared to non-Hispanic White patients in the unadjusted model (HR 1.01, CI 0.90 to 1.14, $P = 0.840$), after basic matching (HR 0.92, CI 0.78 to 1.09, $P = 0.35$), and after propensity score matching (HR 1.08, CI 0.92 to 1.28, $P = 0.35$, Figures 2a to c). Similarly, there was no difference in the incidence of PJI for Hispanic patients compared to non-Hispanic White patients in the unadjusted model (HR 1.07, CI 0.91 to 1.25, $P = 0.420$), after basic matching (HR 1.01, 0.81 to 1.26, $P = 0.930$), and after propensity score matching (HR 0.99, 0.80 to 1.24, $P = 0.950$, Figures 3a to c). Demographic data of these cohorts before and after propensity score matching are presented in Supplemental Tables 2 to 4. The NNEH for one additional person to experience PJI was 160 for non-Hispanic Black patients. Higher incidence of PJI was seen in patients who had all evaluated comorbidities except for abnormal BMI (Table 3). These comorbidities remained significant after basic matching and propensity score matching.

Racial differences in the incidence of AKA after PJI

There was no difference in the incidence of AKA used to control PJI for non-Hispanic Black patients compared to non-Hispanic White patients in the unadjusted model (HR 1.42, CI 0.65 to 3.11, $P = 0.380$), after basic matching (HR 1.27, CI 0.43 to 3.78, $P = 0.670$), and after propensity score matching (HR 0.66, CI 0.26 to 1.71, $P = 0.390$). Demographic data of these cohorts before and after propensity score matching are presented in Supplemental Table 5. Higher incidence of AKA was seen in patients who had congestive heart failure (HR 1.76, CI

1.01 to 3.06, $P = 0.450$), intravenous (IV) drug use (HR 2.68, CI 1.5 to 4.77, $P < 0.001$), peripheral vascular disease (HR 2.51, CI 1.5 to 4.21, $P < 0.001$), diabetes (HR 1.89, CI 1.2 to 2.98, $P = 0.006$), and renal disease (HR 1.77, CI 1.11 to 2.83, $P = 0.017$, Table 4). After propensity score matching, being men (HR 1.94, CI 1.09 to 3.43, $P = 0.023$) was the only comorbidity with higher incidence of AKA.

Discussion

We found that racial disparities exist in incidences of PJI after TKA, specifically, the incidence of PJI was higher in non-Hispanic Black patients when compared to non-Hispanic White patients. Though this disparity was observed even after adjusting for age and sex, there was no difference in incidence of PJI by race after adjusting for comorbidities, suggesting that comorbidities drive the observed racial disparities seen in the incidence of PJI. These findings are consistent with previously published studies demonstrating overall higher incidences of various complications following arthroplasty in the Black population.[9–13] Our findings are consistent with the study by Pinkney et al., who also demonstrated the cumulative incidence of PJI after total joint arthroplasty was higher in non-Hispanic Black patients compared to non-Hispanic White patients after adjusting for age and sex.[21] Unlike prior studies, we also presented the NNEH to better quantify the disparity in absolute terms. An NNEH for Black patients of 160 highlights the magnitude of a problem that is particularly concerning considering that millions of arthroplasties are performed yearly.[1] Importantly, Pinkney et al., found that 26% of the association between incidence of PJI and race was mediated by medical comorbidities,.[21] which, similar to our findings, highlights the impact comorbidities have on racial disparity in PJI. Unlike Pinkney et al., who evaluated comorbidities as a singular aggregate score, we evaluated individual comorbidities and found that nearly all the comorbidities evaluated were associated with a higher incidence of PJI.

Therefore, addressing these comorbidities may mitigate the observed racial differences in risk of PJI.

Our study did not demonstrate a difference in the incidence of AKA used to control PJI after total knee arthroplasty between non-Hispanic Black patients and non-Hispanic White patients. There is conflicting evidence regarding racial disparities and the risk of any amputation after total joint arthroplasty, and even less is known regarding racial disparities in incidence of AKA used to control PJI after TKA.[22–24] Our findings are consistent with the findings by Lieber et al., who found no difference in incidence of AKA used to control PJI after TKA based on race after adjusting for comorbidities and hospital characteristics.[22] However, Lieber et al. did not report an unadjusted odds ratio, so it is unclear whether there was an absolute difference in the risk of AKA used to control PJI after TKA between race. Our study did identify various comorbidities as risk factors for AKA after PJI. As with the incidence of PJI discussed above, our findings suggest that comorbidities are the major factors driving the incidence of AKA used to control PJI after TKA.

Our study is not without potential limitations. Our cohort and outcomes were based on ICD and CPT codes, which may be prone to undercapture and decrease specificity. However, to mitigate this issue and increase generalizability, we selected ICD-10 and CPT codes utilized in previously published studies.[21,22] Additionally, we were not able to evaluate social vulnerability, a measure of patients' healthcare inaccessibility based on socioeconomic factors, which has been shown to be an important factor influencing racial disparities in arthroplasty outcomes.[25–27] Our analysis also lacked robust regression analysis to evaluate the relationship between various variables, and it also lacked mediation analysis to better evaluate race as a direct effect on outcomes. However, due to limitations in the analytics platform used, our hdPS-matched analysis was the most effective way of determining the effect of race, adjusting for various comorbidities. Additionally, our analytic platform did not support hospital-level identifiers; thus, we could not perform any sensitivity analysis to address site-level variations in PJI diagnosis and management. Also, our cohort overrepresented non-Hispanic White patients and underrepresented Black and Hispanic patients compared to the general US population, which may limit generalizability. However, the dataset reflected real-world clinical practice patterns at the contributing institutions and provided meaningful insights into outcomes for the population studied. Future studies incorporating more diverse populations will be important to assess the external validity of these findings across broader demographic groups.

Conclusion

In our large-scale observational study, we found evidence of racial disparities in incidence of PJI after TKA, which were largely driven by medical comorbidities. Our study highlights the importance of providing comprehensive care to address overall patient health to mitigate these observed racial disparities in PJI after TKA.

CRediT authorship contribution statement

Daisuke Furukawa: conceptualization, methodoogy, formal analysis, writing-original draft, writing- review & editing. C. William Pike: methodology, formal analysis, resources, visualization, writing- review & editing. Gavin Huy: methodology, formal analysis, resources, visualization, writing- review & editing. Jeremy Coyle: methodology, formal analysis, software, resources, visualization, writing- review & editing. Derek F. Amanatullah: methodology, formal analysis, writing- review & editing, supervision

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Table 1: Demographics of patients who underwent arthroplasty stratified by race

	Non-Hispanic White	Hispanic	Non-Hispanic Black	Non-Hispanic Others
N	152,270	4,259	10,712	7,964
Women	91,611 (60.2)	2,686 (63.1)	7,970 (74.4)***	5,169 (64.9)
Age	68±8.6	65±9.7***	64±9.4***	68±8.9
<18 years	0 (0)	0 (0)	0 (0)	0 (0)
18-29 years	110 (0.1)	13 (0.3)	15 (0.1)	12 (0.2)
30-39 years	440 (0.3)	35 (0.8)	60 (0.6)	19 (0.2)
40-49 years	3,615 (2.4)	197 (4.6)	603 (5.6)	220 (2.8)
50-59 years	20,372 (13.4)	886 (20.8)	2,683 (25)***	1,113 (14)
60-69 years	56,210 (36.9)	1,641 (38.5)	4,170 (38.9)	2,926 (36.7)
70-79 years	60,088 (39.5)	1,262 (29.6)	2,758 (25.7)***	3,120 (39.2)
80-89 years	11,435 (7.5)	225 (5.3)	423 (3.9)	554 (7)
>=90 years	0 (0)	0 (0)	0 (0)	0 (0)
Follow up duration (days)	1,748.7±981.8	1,685.1±1036.9	1,742.4±1019.3	1,640.6±959.6
Charlson Comorbidity Index	4.4±2.8	4.1±2.7	4.4±3.1	4.5±2.7
Malignancy	22,157 (14.55)	468 (10.99)	1,282 (11.97)	1020 (12.81)
Metastatic Solid Tumor	2,726 (1.79)	58 (1.36)	175 (1.63)	118 (1.48)
Diabetes without Complications	22,297 (14.64)	900 (21.13)	2,140 (19.98)	1,488 (18.68)
Diabetes with Complications	17,068 (11.21)	655 (15.38)	1,918 (17.91)	1,230 (15.44)
Congestive Heart Failure	15,092 (9.91)	319 (7.49)	1,367 (12.76)	700 (8.79)
Myocardial Infarction	9,224 (6.06)	199 (4.67)	560 (5.23)	447 (5.61)
Peripheral Vascular Disease	27,625 (18.14)	681 (15.99)	1,893 (17.67)	1,415 (17.77)
Chronic Pulmonary Disease	46,449 (30.5)	1,089 (25.57)	3,498 (32.65)	2,169 (27.24)
Cerebrovascular Disease	20,036 (13.16)	459 (10.78)	1,363 (12.72)	1,069 (13.42)
Dementia	2,427 (1.59)	70 (1.64)	179 (1.67)	160 (2.01)
Hemiparaplegia	1,630 (1.07)	35 (0.82)	181 (1.69)	103 (1.29)
Mild Liver Disease	17,133 (11.25)	627 (14.72)	1,257 (11.73)	921 (11.56)
Severe Liver Disease	717 (0.47)	35 (0.82)	45 (0.42)	42 (0.53)
Renal Disease	20,036 (13.16)	466 (10.94)	1,953 (18.23)	1,061 (13.32)
Peptic Ulcer Disease	5,028 (3.3)	143 (3.36)	401 (3.74)	248 (3.11)
Rheumatic Disease	12,191 (8.01)	469 (11.01)	1,212 (11.31)	700 (8.79)
HIV	171 (0.11)	11 (0.26)	97 (0.91)	18 (0.23)

Intravenous drug use	3,284 (2.16)	111 (2.61)	476 (4.44)	153 (1.92)
Hemoglobin A1c	6.1±0.9	6.3±1***	6.2±0.9	6.2±0.9
BMI	32.3±6	32.8±5.8	34.5±6.3***	30.7±5.9***

Data presented as mean ± SD or n (%).

*** Denotes Standardized Mean Difference (SMD) > 0.25 with Non-Hispanic White as reference

HIV: human immunodeficiency virus, BMI: body mass index

Table 2: Demographics of patients with diagnosis of periprosthetic joint infection after arthroplasty

	Non-Hispanic White	Hispanic	Non-Hispanic Black	Non-Hispanic Others
N	1,225	33	112	64
Women	570 (46.5)	13 (39.4)	67 (59.8)***	30 (46.9)
Mean age	68±8.8	65±10.5***	64±10.1***	67±10.9
<18 years	0 (0)	0 (0)	0 (0)	0 (0)
18-29 years	1 (0.1)	0 (0)	1 (0.9)	0 (0)
30-39 years	3 (0.2)	1 (3)***	2 (1.8)***	1 (1.6)
40-49 years	37 (3)	2 (6.1)	6 (5.4)	4 (6.2)
50-59 years	155 (12.7)	3 (9.1)	25 (22.3)***	7 (10.9)
60-69 years	456 (37.2)	17 (51.5)***	45 (40.2)	24 (37.5)
70-79 years	471 (38.4)	9 (27.3)	30 (26.8)	22 (34.4)
80-89 years	102 (8.3)	1 (3)	3 (2.7)	6 (9.4)
>=90 years	0 (0)	0 (0)	0 (0)	0 (0)
Follow up duration (days)	1,589.9±860.2	1,690.1±821	1,428±847.4	1,414.8±753
Charlson Comorbidity Index	6±3.5	5.8±4.5	6.5±4.2	6.5±3.9
Malignancy	211 (17.22)	5 (15.15)	23 (20.54)	17 (26.56)
Metastatic Solid Tumor	41 (3.35)	2 (6.06)	7 (6.25)	0 (0)
Diabetes without Complications	217 (17.71)	3 (9.09)	14 (12.5)	13 (20.31)
Diabetes with Complications	271 (22.12)	12 (36.36)	31 (27.68)	18 (28.12)
Congestive Heart Failure	298 (24.33)	9 (27.27)	37 (33.04)	17 (26.56)
Myocardial Infarction	150 (12.24)	6 (18.18)	14 (12.5)	11 (17.19)
Peripheral Vascular Disease	463 (37.8)	10 (30.3)	54 (48.21)	23 (35.94)
Chronic Pulmonary Disease	523 (42.69)	13 (39.39)	64 (57.14)***	28 (43.75)
Cerebrovascular Disease	258 (21.06)	6 (18.18)	26 (23.21)	21 (32.81)***
Dementia	56 (4.57)	0 (0)	4 (3.57)	3 (4.69)
Hemiparaplegia	42 (3.43)	2 (6.06)	3 (2.68)	2 (3.12)
Mild Liver Disease	243 (19.84)	6 (18.18)	21 (18.75)	14 (21.88)
Severe Liver Disease	24 (1.96)	0 (0)	3 (2.68)	0 (0)
Renal Disease	300 (24.49)	5 (15.15)	37 (33.04)	23 (35.94)***
Peptic Ulcer Disease	83 (6.78)	4 (12.12)	11 (9.82)	4 (6.25)
Rheumatic Disease	181 (14.78)	6 (18.18)	27 (24.11)***	11 (17.19)
HIV	0 (0)	0 (0)	1 (0.89)***	1 (1.56)***
Intravenous drug use	84 (6.86)	3 (9.09)	8 (7.14)	5 (7.81)
Hemglobin A1c	6.3±1.2	7±0.7***	6.3±0.9	6.8±1.5
BMI	32.8±6.4	32.3±5.8	33.5±6.7	32±5.9

Data presented as mean ± SD or N (%).

*** Denotes Standardized Mean Difference (SMD) > 0.25 with Non-Hispanic White as reference

HIV: human immunodeficiency virus, BMI: body mass index

Table 3: Risk factors of periprosthetic joint infection after arthroplasty

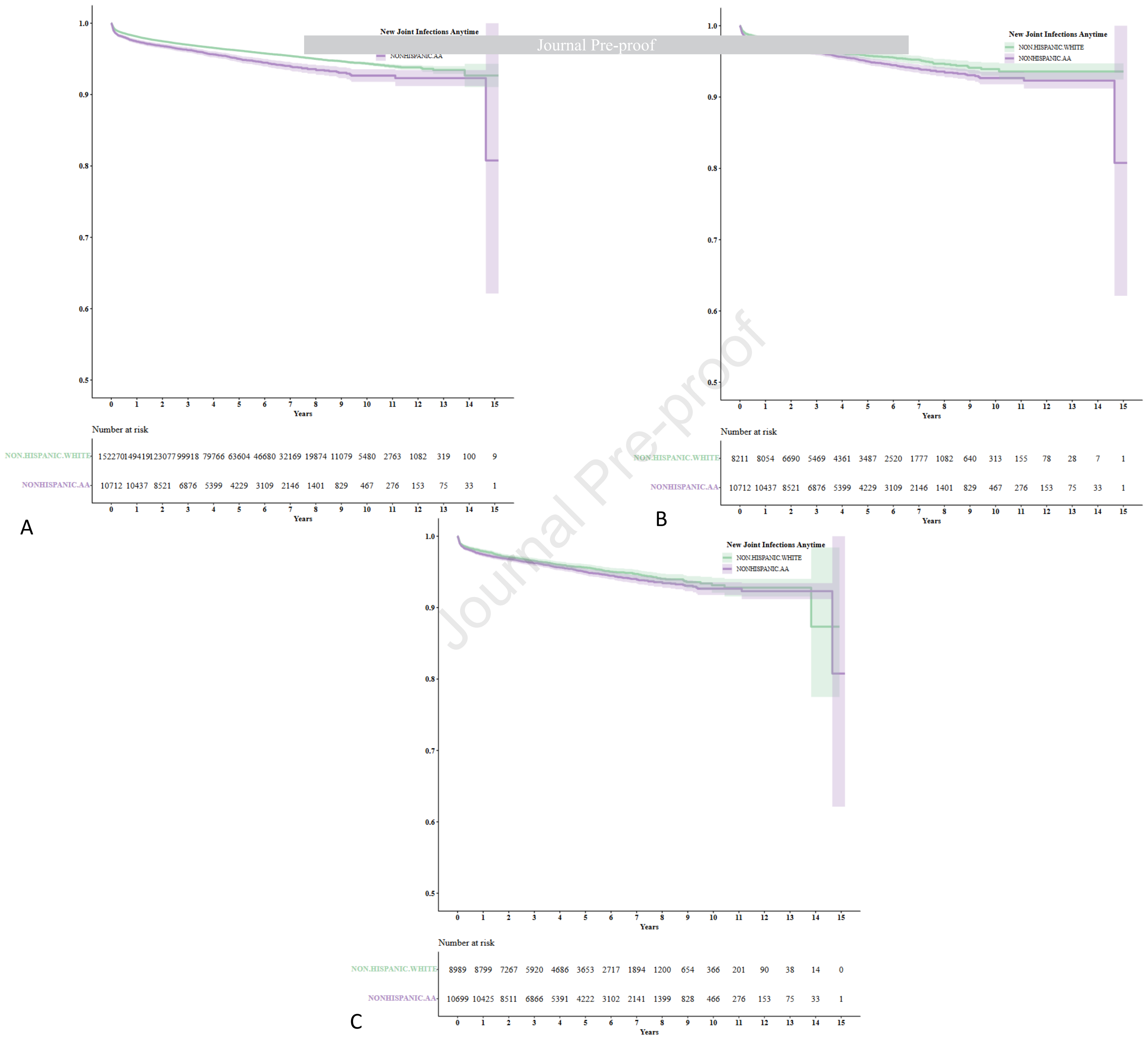
	Ref N	Ref events	Intervention N	Intervention events	HR (95% CI)	*P*-value
Congestive heart failure						
Unadjusted	201,138	5,911	25,589	1,408	1.96 (1.85-2.08)	<0.001
basic-match	14,145	411	25,589	1,408	1.94 (1.74-2.16)	<0.001
propensity-match	16,617	600	25,578	1,407	1.55 (1.41-1.70)	<0.001
Intravenous Drug use						
unadjusted	243,339	8,347	5,943	409	2.24 (2.03-2.48)	<0.001
basic-match	5,256	190	5,943	409	2.09 (1.76-2.48)	<0.001
propensity-match	5,338	256	5,943	409	1.45 (1.24-1.7)	<0.001
Peripheral vascular disease						
unadjusted	166,165	4,426	46,697	2,263	1.89 (1.80-1.99_	<0.001
basic-match	17,303	439	46,697	2,263	1.94 (1.75-2.15)	<0.001
propensity-match	24,156	745	45,105	2,146	1.54 (1.42-1.68)	<0.001
Diabetes mellitus						
unadjusted	163,718	4,856	68,023	3,001	1.48 (1.41-1.55)	<0.001
basic-match	21,628	641	68,023	3,001	1.47 (1.35-1.60)	<0.001
propensity-match	17,867	642	41,332	1,766	1.16 (1.06-1.28)	<0.001
Liver disease						
unadjusted	199,235	6,472	29,747	1,349	1.49 (1.41-1.58)	<0.001
basic-match	15,978	529	29,747	1,349	1.45 (1.31-1.60)	<0.001
propensity-match	22,688	919	29,746	1,349	1.13 (1.04-1.23)	0.004
Renal disease						
unadjusted	190,742	5,755	34,744	1,519	1.5 (1.42-1.59)	<0.001
basic-match	15,744	434	34,744	1,519	1.61 (1.45-1.79)	<0.001
propensity-match	16,410	613	30,733	1,310	1.13 (1.03-1.25)	0.01
Rheumatic disease						
unadjusted	223,477	7,372	21,396	1,197	1.72 (1.62-1.83)	<0.001
basic-match	12,689	403	21,396	1,197	1.78 (1.59-2.00)	<0.001
propensity-match	15,405	686	18,420	1,027	1.25 (1.14-1.38)	<0.001
BMI (>25)						
unadjusted	21,715	16	211,170	156	0.95 (0.57-1.59)	0.84
basic-match	21,715	16	9,564	8	1.1 (0.47-2.57)	0.83
propensity-match	21,715	16	18,524	7	0.51 (0.21-1.23)	0.133
Men						
unadjusted	155,558	5,016	98,471	4,330	1.40 (1.34-4.45)	<0.001
basic-match	14,027	495	98,471	4,330	1.26 (1.15-1..39)	<0.001
propensity-match	41,721	1,258	98,471	4,330	1.49 (1.40-1.59)	<0.001

BMI: body mass index

Table 4: Risk factors for above knee amputation after periprosthetic joint infection

	Ref N	Ref events	Intervention N	Intervention events	HR (95% CI)	*P*-value
Congestive heart failure						
Unadjusted	507	20	507	34	1.76 (1.01-3.06)	0.045
basic-match	1,204	38	513	35	2.27 (1.43-3.59)	<0.001
propensity-match	276	12	276	11	0.92 (0.41-2.1)	0.85
Intravenous Drug use						
unadjusted	1,758	66	147	14	2.68 (1.50-4.77)	<0.001
basic-match	147	6	147	14	2.5 (0.96-6.51)	0.061
propensity-match	147	7	147	14	1.93 (0.78-4.79)	0.155
Peripheral vascular disease						
unadjusted	855	21	760	46	2.51 (1.5-4.21)	<0.001
basic-match	615	9	615	38	4.28 (2.07-8.85)	<0.001
propensity-match	407	11	407	21	1.88 (0.91-3.90)	0.091
Diabetes mellitus						
unadjusted	995	31	788	47	1.89 (1.20-2.98)	0.006
basic-match	777	26	777	45	1.7 (1.05-2.76)	0.031
propensity-match	279	14	279	13	0.89 (0.42-1.90)	0.77
Liver disease						
unadjusted	1,376	52	404	24	1.62 (1.00-2.63)	0.051
basic-match	404	9	404	24	2.81 (1.31-6.05)	0.008
propensity-match	379	23	379	19	0.81 (0.44-1.49)	0.5
Renal disease						
unadjusted	1,132	40	512	31	1.77 (1.11-2.83)	0.017
basic-match	510	14	510	30	2.18 (1.16-4.12)	0.016
propensity-match	248	11	248	14	1.28 (0.58-2.81)	0.54
Rheumatic disease						
unadjusted	1,581	68	319	15	1.09 (0.62-1.91)	0.76
basic-match	318	17	318	15	0.88 (0.44-1.76)	0.71
propensity-match	261	11	261	13	1.16 (0.52-2.59)	0.71
BMI (>25)						
unadjusted	138	5	1,747	73	0.45 (2.74-1.11)	0.82
basic-match	138	5	138	5	0.93 (0.27-3.23)	0.91
propensity-match	138	5	138	6	1.12 (0.34-3.68)	0.85
Men						
unadjusted	1,279	52	1,423	70	1.21 (0.85-1.73)	0.29
basic-match	1,254	50	1,254	59	1.18 (0.81-1.72)	0.39
propensity-match	568	18	568	34	1.94 (1.09-3.43)	0.023

BMI: body mass index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New Joint Infections Anytime
NON.HISPANIC.WHITE
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Years
Number at risk
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NONHISPANIC.AA 10712 10437 8521 6876 5399 4229 3109 2146 1401 829 467 276 153 75 33 1
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New Joint Infections Anytime
NON.HISPANIC.WHITE
NONHISPANIC.AA
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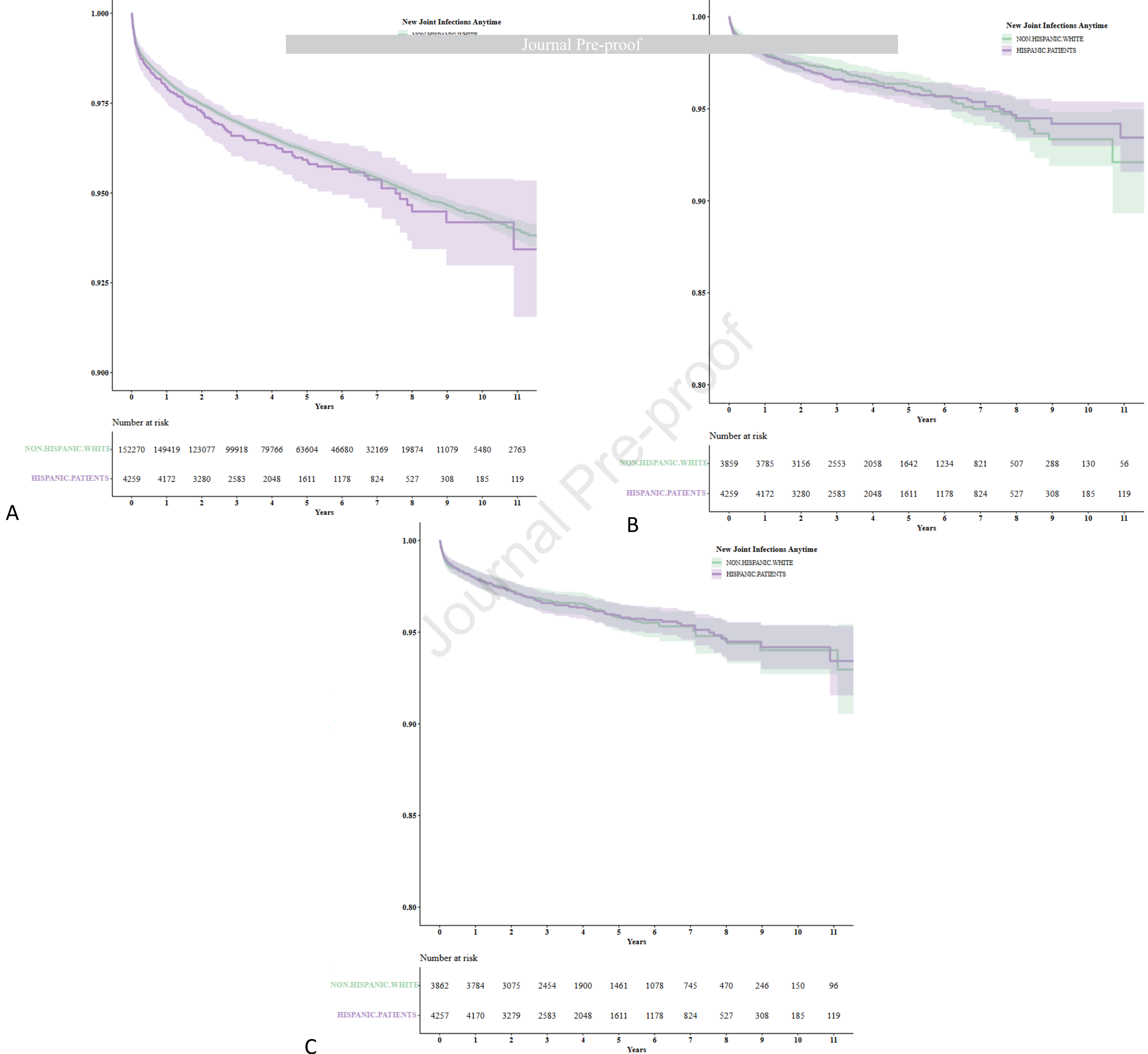
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HISPANIC.PATIENTS 4259 4172 3280 2583 2048 1611 1178 824 527 308 185 119
Years
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Years
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Years
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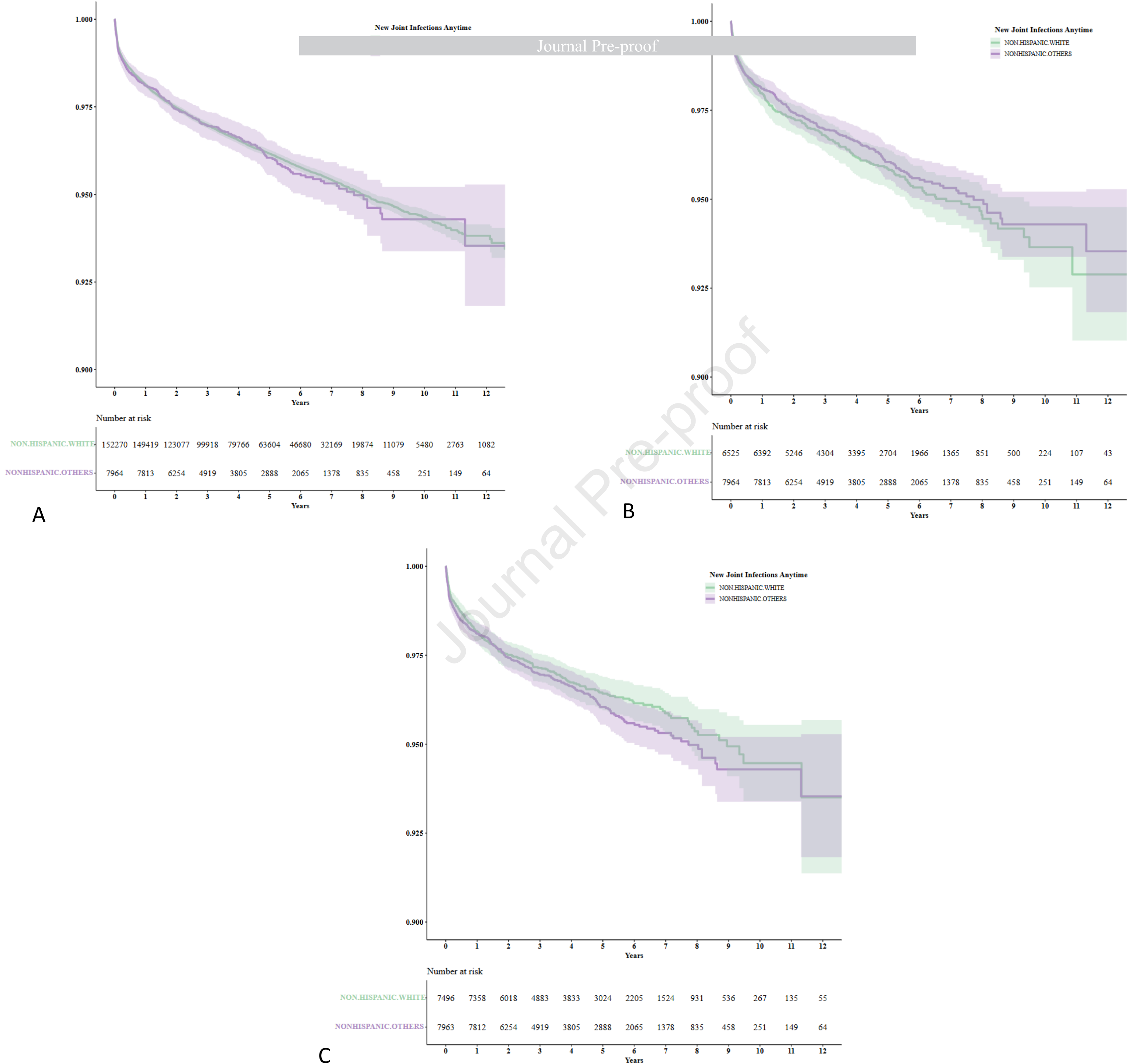
New Joint Infections Anytime
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Number at risk
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NONHISPANIC.OTHERS 7964 7813 6254 4919 3805 2888 2065 1378 835 458 251 149 64
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New Joint Infections Anytime
NON.HISPANIC.WHITE
NONHISPANIC.OTHERS
Number at risk
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NONHISPANIC.OTHERS 7964 7813 6254 4919 3805 2888 2065 1378 835 458 251 149 64
B
New Joint Infections Anytime
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NONHISPANIC.OTHERS
Number at risk
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NONHISPANIC.OTHERS 7963 7812 6254 4919 3805 2888 2065 1378 835 458 251 149 64
C

Figure Legends

Figure 1 Kaplan-meier curves of incidence of new periprosthetic joint infection after arthroplasty comparing non-Hispanic White versus non-Hispanic Black after. a) unadjusted analysis, b) basic matching, and c) propensity score matching

Figure 2 Kaplan-meier curves of incidence of new periprosthetic joint infection after arthroplasty comparing non-Hispanic White versus Hispanic after. a) unadjusted analysis, b) basic matching, and c) propensity score matching

Figure 3 Kaplan-meier curves of incidence of new periprosthetic joint infection after arthroplasty comparing non-Hispanic White versus non-Hispanic Other after. a) unadjusted analysis, b) basic matching, and c) propensity score matching

INDIVIDUAL CONFLICT OF INTEREST STATEMENT

American Association of Hip and Knee Surgeons

(Adopted from the American Academy of Orthopaedic Surgeons disclosure statement)

The following form **must be filled out completely and submitted by each author (example, 6 authors, 6 forms). All items require a response. If there is no relevant disclosure for a given item, enter "*None*."**

Manuscript Title Racial Disparities Affect the Incidence of Periprosthetic Joint Infection after Total Joint Arthroplasty

1. Royalties from a company or supplier (The following conflicts were disclosed)
Exactech, Medacta, Restor3D, Corin

2. Speakers bureau/paid presentations for a company or supplier (The following conflicts were disclosed)
None

3A. Paid employee for a company or supplier (The following conflicts were disclosed)
None

3B. Paid consultant for a company or supplier (The following conflicts were disclosed)
J&J MedTech, Exactech, Medacta, Restor3D, Corin, Onkos, Bone Support, Hareaus

3C. Unpaid consultants for a company or supplier (The following conflicts were disclosed)
None

4. Stock or stock options in a company or supplier (The following conflicts were disclosed)
Knimble Designs, Zooly Labs, *n*Sight Surgical, Restor3D, QTI, Recoup Fitness, Well Beam

5. Research support from a company or supplier as a Principal Investigator (The following conflicts were disclosed)
None

6. Other financial or material support from a company or supplier (The following conflicts were disclosed)
None

7. Royalties, financial or material support from publishers (The following conflicts were disclosed)
None

8. Medical/Orthopaedic publications editorial/governing board (The following conflicts were disclosed)
Journal of Bone and Joint Infection

9. Board member/committee appointments for a society (The following conflicts were disclosed)
AAOS, Knee Society

Each author must sign AND print or type his/her name, date and submit a separate form

In addition, one BLINDED Conflict of Interest form (no author names used) should be submitted per manuscript with all author disclosures.

Derek Amanatullah	[signature]	10/5/25
Author Name (Print or Type)	Author Signature	Date

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Daisuke Furukawa	[signature]	10/14/25
Author Name (Print or Type)	Author Signature	Date