The Interaction of Race and Socioeconomic Deprivation in Treatment of Patellofemoral Instability: Data from the JUPITER Cohort

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INTRODUCTION:

Patients who are of a minority race or lower socieconomic status tend to present with greater severity of their musculoskeletal conditions and may undergo different treatment from their White or more socioeconmically advantaged counterparts. Patellofemoral instability (PFI) is a challenging disorder that disrupts the function and quality-of-life of affected patients. Although advances have been made in interventions that restore stability and protect the patellofemoral joint from early deterioration, it is not clear whether the diagnosis and treatment of PFI has been equitable between racial and socioeconomic groups. The purpose of this study was to determine the effects of race and socioeconomic disadvantage on the severity of patellar instability at initial presentation.

METHODS:

A prospectively-enrolled, multicenter cohort study (JUPITER: Justifying Patellar Instability Treatment by Results) database, with this question determined a priori, was queried for patients enrolled between December 2016 and September 2022 who had 5-digit zip code data available. Patients were excluded if zip code, race, history, treatment, or baseline patient-reported outcome (PROM) data was unavailable. Patients enrolled bilaterally were reduced to their first-enrolled knee, and their contralateral knee excluded, to avoid duplicate counting of race or socioeconomic data. National percentile area deprivation index (ADI) rankings were calculated for each 5-digit zip code and stratified by ADI (low (Q1), medium (Q2-Q3), high (Q4)), where higher ADI indicates greater socioeconomic disadvantage. To improve power of analysis, race was categorized into White, Black, or Other race, which included subjects who were Asian, Hispanic, Native American, Native Hawaian, Indian, Cape Verdean, and multiracial, as well as patients who selected “Other race” but did not specify (**Table 1**). ANOVA analysis was performed to analyze differences in means between the three ADI groups. Analysis was conducted using generalized linear mixed models incorporating age, gender, BMI, race/ethnicity, and ADI category as fixed effects. A random residual effect for organization was included to adjust for clustering by hospital. Interaction terms were considered between race/ethnicity and ADI in each model, and included where significant. Outcomes analyzed in this model included first-time vs. recurrent dislocator status at time of intervention, number of dislocations at time of treatment, type of treatment (isolated medial patellofemoral ligament reconstuction (MPFL-R) vs. MPFL-R + Tibal Tubercle Osteotomy (TTO), patellofemoral chondroplasty, osteochondral fracture treatment), presence and location of Outerbridge Grade III/IV chondral lesions, and baseline patient-reported outcome measures (KOOS Pain, KOOS QOL, Banff Patellar Instablity Index 2.0, IKDC).

RESULTS:

1215 unique patients (16.6 ± 4.12 years old, 61.7% female) had available zip code, race, ADI, history, treatment, and baseline PROM data. Mean national ADI percentile rank was 38.1 ± 7.6 (Q2-Q3). Patients in the high ADI group were more frequently Black (13% vs. 3.2% in the Low ADI group, $p < 0.0001$), and patients in the high ADI group had a significantly higher mean BMI than the Low ADI group (24.95 ± 8.5 vs. 23.04 ± 6.34, $p = 0.0001$). High ADI patients were less likely to undergo chondroplasty (33.8% vs. 45.1%, $p = 0.0041$) and less likely to undergo osteochondral fracture treatment (9.8% vs. 17.3%, $p = 0.0099$) than their low ADI counterparts. High ADI patients also had a lower baseline KOOS Pain score than Low ADI patients (66.8 ± 22.4 vs. 71.1 ± 22.5, $p = 0.0483$) ($p=0.0167$). There were no significant differences in baseline KOOS QOL, IKDC, or BPII 2.0 based on ADI ($p > 0.05$) (**Table 2**).

For the generalized linear mixed models (**Tables 3-4)**, Other race patients were more likely to be First-Time Dislocators, whereas Female patients and patients with a higher BMI wer more likely to be a recurrent disocator. Black race, high ADI, and being both of Black race and High ADI were predictive of an increased number of dislocations at the time of presentation. Being female and older age were each associated with a decreased KOOS Pain score at presentation. Race and ADI did not have a statistically significant association with any of the four baseline PROM scores.

DISCUSSION AND CONCLUSION:

Patellar instability patients with greater socioeconomic disadvantage (higher ADI) were more often Black and had a higher mean BMI than those of lower ADI. Higher ADI was associated with worse pain scores at baseline and a lower likelihood of undergoing chondroplasty and osteochondral fracture treatment. Higher ADI was also associated with an increased number of dislocations prior to presentation. Understanding the role of race and socioeconomic status in the treatment of

patients with patellar instability will be helpful to optimize the workup and treatment of this disorder among disadvantaged groups. Future studies are warranted to examine the short- and long-term outcomes of patients treated for patellar instabilty based on race and socioeconomic status.

Table 2. Patient Characteristics by ADI Rank

Variable	Low		Med		High		P-Value
Age	17.04	4.31	16.65	4.29	16.19	3.70	0.0035
Gender							0.2771
Male	142	35.50	152.00	38.19	166.00	40.99	
Female	258.00	64.50	246.00	61.81	239.00	59.01	
Race							<.0001
White	323.00	79.75	325.00	80.45	317.00	78.08	
Black or AA	13.00	3.21	28.00	6.93	53.00	13.05	
Other	69.00	17.04	51.00	12.62	36.00	8.87	
Race: White vs. Non-White							0.6927
White	82.00	20.25	79.00	19.55	89.00	21.92	
Non-White	323.00	79.75	325.00	80.45	317.00	78.08	
BMI	23.04	6.34	24.24	7.67	24.95	8.47	0.0001
Skeletal Maturity							0.0585
Mature	290.00	73.60	257.00	66.58	258.00	67.01	
Immature	104.00	26.40	129.00	33.42	127.00	32.99	
Beighton Index (mean, sd)	4.25	2.94	3.36	3.01	2.76	2.73	<.0001
Beighton Index > 5 (n, %)							<.0001
Yes	144.00	50.70	85.00	36.17	68.00	27.20	
No	140.00	49.30	150.00	63.83	182.00	72.80	
Positive Family History							0.8289
Yes	144.00	35.56	152.00	37.62	148.00	36.45	
No	261.00	64.44	252.00	62.38	258.00	63.55	
First-Time Dislocator							0.5056
Yes	135.00	33.83	146.00	37.06	148.00	37.47	
No	264.00	66.17	248.00	62.94	247.00	62.53	
Number of dislocations/subluxations	4.58	6.42	4.50	8.43	6.10	13.50	0.2163
Surgical Treatment	sum						0.3937
Isolated MPFL	207.00	52.27	214.00	53.77	232.00	58.73	
MPFL + TTO	61.00	15.40	55.00	13.82	51.00	12.91	
Neither MPFL or TTO	16.00	4.04	23.00	5.78	13.00	3.29	
Non-Operative	112.00	28.28	106.00	26.63	99.00	25.06	
Grade III/IV Patellar or Trochlear Lesions							0.0027
Yes	78.00	27.46	46.00	15.70	65.00	21.67	
No	206.00	72.54	247.00	84.30	235.00	78.33	
Cartilage Lesion Locations							0.9722
Patella	62.00	79.49	36.00	78.26	50.00	76.92	
Trochlea	11.00	14.10	7.00	15.22	9.00	13.85	
Bipolar	5.00	6.41	3.00	6.52	6.00	9.23	
Unipolar vs. Bipolar							
Unipolar							

Table 3. Number of Dislocations

Variable		Estimate	SE	P-Value
Age		0.03	0.02	0.1725
Gender				
	Female	0.00	0.16	0.9907
BMI		-0.02	0.01	0.1512
Race				
	Black	1.17	0.43	0.0152
	Other	-0.29	0.43	0.5088
ADI				
	Medium	0.17	0.21	0.4363
	High	0.53	0.19	0.0151
ADI*Race/Ethnicity				
	Medium*Black	-1.68	0.76	0.0518
	Medium*Other Race	-0.21	0.66	0.7594
	High*Black	-1.82	0.63	0.0166
	High*Other Race	-0.64	0.77	0.4247

Table 1. Race/Ethnicity Responses Categorized Under 'Other'

Race	Frequency	Percent
Hispanic or Latino	44	28.21
Asian	43	27.56
Other (Native American, Native Hawaiian, Indian, Cape Verdean, Other Unspecified)	23	14.74
White, Hispanic or Latino	22	14.1
White, African American	7	4.49
White, Asian	5	3.21
White, Other	4	2.56
Hispanic or Latino, Other	3	1.92
Asian, Other	1	0.64
Asian, Unspecified	1	0.64
White, Asian, Other	1	0.64
White, African American, Other	1	0.64
White, African American, Hispanic or Latino	1	0.64
Total	156	