Association Between Area Deprivation Index and Follow-Up Attrition After ACL Reconstruction

Introduction: Following ACL reconstruction, attrition from follow-up care can jeopardize continuity of care, outcome evaluation, and rehabilitation monitoring. The ADI's measurement of social determinant of health may have an impact on follow-up visit adherence. There is currently little data on associations specific to age and sex. We hypothesize that patients from more socioeconomically disadvantaged neighborhoods measured by the Area Deprivation Index (ADI), would have earlier attrition from follow-up after anterior cruciate ligament (ACL) reconstruction.

Methods: A retrospective analysis was conducted on 746 patients who underwent ACLR between 2016 and 2024. National ADI scores obtained from patient ZIP codes were associated with demographic information (age, sex, and ZIP code). Follow-up attrition was defined as a patient did not visit the clinic within a year after surgery. Time to last follow-up was evaluated using Kaplan-Meier analysis and Cox proportional hazards models, and the odds of early attrition were estimated using logistic regression.

Results: The mean age of the cohort was 27.4 ± 11.6 years; 40.6% were female. Overall, 80.7% of patients had their last follow-up before one year, with a median time of 244 days. Among women, a 25 unit higher ADI is associated with a 13% higher rate of attrition that is statistically significant, HR (95% CI) 1.13 (1.01, 1.27). This relationship was particularly noticeably among women <18 and women 35+. There was no evidence of association between ADI and attrition among men.

Discussion: Patients from socioeconomic disadvantage neighborhoods that was measured by the ADI are associated with earlier attrition from follow up care after ACLR among women, but not men. These findings highlight the importance for target interventions to address barriers to postoperative care to socioeconomically disadvantaged patients. One of the limitations in the study is that attrition is defined as absence of follow up visit within a year of surgery. Patients who continued care outside of the institution were not reported. The study also represents a single health system and may limit reproducibility.

Significance/Clinical Relevance: ADI can serve as a useful tool to identify patients at higher risk for loss to follow-up and to guide the development of targeted interventions.

Table 1. Descriptive statistics for post-ACL study, N=746.

Characteristics	Overall	Males (n=443)	Females (n=303)
Female, n (%)	303 (40.6)		
Age in years, mean ± SD, range=10-72	27.4 ± 11.6	26.6 ± 11.0	28.4 ± 12.3
Age categories, n (%)			
<18	170 (22.8)	101 (22.8)	69 (22.8)
18-34	389 (52.1)	246 (55.6)	143 (47.2)
35+	187 (25.1)	96 (21.7)	91 (30.0)
National ADI, mean ± SD, range=3-100	48.2 ± 26.8	49.8 ± 26.9	45.9 ± 26.5
Grouped ADI, n %			
ADI<25	191 (25.6)	104 (23.5)	87 (28.7)
25≤ADI<50	224 (30.0)	130 (29.3)	94 (31.0)
50≤ADI<75	162 (21.7)	99 (22.3)	63 (20.8)
75≤ADI	169 (22.7)	110 (24.8)	59 (19.5)
Last visit prior to 3 months from surgery, n (%)	105 (14.1)	72 (16.3)	33 (10.9)
Last visit prior to 6 months from surgery, n (%)	232 (31.1)	147 (33.2)	85 (28.1)
Last visit prior to 1 year from surgery, n (%)	602 (80.7)	362 (81.7)	240 (79.2)
Days from surgery to last visit, median (95% CI) using Kaplan-Meier estimates	244 (232, 258)	243 (225, 258)	248 (228, 271)

SD=standard deviation; ADI=area deprivation index; CI=confidence intervals

Table 2. Associations between National ADI and post-ACL reconstruction attrition, N=746.

National ADI main effect	Time to last visit	Last visit prior to 1 year
25 units higher effect	HR (95% CI)	OR (95% CI)
Stratified by sex		
Males	0.98 (0.89, 1.08)	0.97 (0.77, 1.21)
Females	**1.13 (1.01, 1.27)**	1.32 (1.00, 1.74)
Stratified by sex and age		
Males, age<18	1.00 (0.81, 1.24)	0.96 (0.58, 1.59)
Males, 18≤age<35	1.01 (0.89, 1.15)	1.10 (0.81, 1.51)
Males, 35≤age	0.88 (0.71, 1.10)	0.70 (0.45, 1.11)
Females, age<18	1.22 (0.94, 1.58)	1.44 (0.77, 2.68)
Females, 18≤age<35	1.04 (0.87, 1.24)	1.12 (0.75, 1.68)
Females, 35≤age	**1.23 (1.01, 1.49)**	1.56 (0.95, 2.55)
Group effects (vs ADI<25)		
Stratified by sex		na
Males		
25≤ADI<50 (vs ADI<25)	1.14 (0.86, 1.51)	
50≤ADI<75 (vs ADI<25)	0.82 (0.60, 1.12)	
75≤ADI (vs ADI<25)	1.10 (0.82, 1.48)	
Females		
25≤ADI<50 (vs ADI<25)	1.23 (0.88, 1.72)	
50≤ADI<75 (vs ADI<25)	1.28 (0.95, 2.00)	
75≤ADI (vs ADI<25)	**1.48 (1.02, 2.15)**	

HR=hazards ratio; CI=confidence interval;
HR for ADI main effect shown in **BOLD** if statistically significant at alpha=0.05
Cox proportional hazards (PH) modeling time to last visit, censored at 1 year post-surgery;
PH assumption verified for all covariables.
All models include national ADI, sex, and age parameters

Figure 1. Kaplan-Meier estimates for time to last visit, by National ADI and separately by sex .

Product-Limit Survival Estimates
With Number of Subjects at Risk

Males

National ADI
0-24
25-49
50-74
75-100

+ Censored

0-24	104	84	66	34	0
25-49	130	98	76	35	0
50-74	99	90	70	37	0
75-100	110	89	63	33	0

Days from surgery to last visit

Product-Limit Survival Estimates
With Number of Subjects at Risk

Females

National ADI
0-24
25-49
50-74
75-100

+ Censored

0-24	87	80	59	36	0
25-49	94	81	64	29	0
50-74	63	51	38	19	0
75-100	59	50	36	15	0

Days from surgery to last visit