



After Anterior Cruciate Ligament Injury, Patients With Medicaid Insurance Experience Delayed Care and Worse Clinical Outcomes Than Patients With Non-Medicaid Insurance

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Purpose: To evaluate the effects of socioeconomic factors on the operative treatment of anterior cruciate ligament injuries and outcomes following surgical reconstruction. **Methods:** A retrospective cohort study of primary anterior cruciate ligament reconstruction surgeries at a single institution performed from 2011 to 2015 with minimum 2-year follow-up was conducted. Patient demographics, insurance type, workers' compensation status, surgical variables, International Knee Documentation Committee score, and failure were recorded from chart review. Education level and income were obtained via phone interview. Differences between functional outcome were compared between Medicaid and non-Medicaid groups. **Results:** In total, 268 patients were included in the analysis (43 patients in the Medicaid group and 225 patients in the non-Medicaid group, overall mean follow-up of 3.1 ± 0.8 years). The Medicaid group demonstrated lower annual income ($P < .001$) and a lower level of completed education compared with the non-Medicaid group ($P < .001$). Patients who received Medicaid had a greater duration between time of initial knee injury and surgery compared with the those in non-Medicaid group (11.8 ± 16.3 months vs 6.1 ± 16.5 months, $P < .001$). At the time of follow-up, patients in the non-Medicaid group had a significantly greater International Knee Documentation Committee score compared with patients who received Medicaid (82.5 ± 13.8 vs 75.3 ± 20.8 , $P = .036$). **Conclusions:** Patients with Medicaid insurance were seen in the clinic significantly later after initial injury and had worse outcomes compared with patients with other insurance types. Also, patients in higher annual income brackets had significantly better clinical outcomes scores at a minimum of 2 years postoperatively. **Level of Evidence:** Level III, retrospective cohort study.

Evidence-based medicine has shown that postoperative outcomes are influenced by a wide range of variables, including injury severity, comorbidities, surgical technique, and rehabilitation protocols.¹⁻⁵ However, many of these variables are not within physician control, and thus, addressing them can be challenging. Socioeconomic status is one such variable

that has been shown to affect surgical outcomes across a wide variety of specialties.⁶⁻⁹

Anterior cruciate ligament reconstruction (ACLR) is a major surgery that can potentially require multiple preoperative visits with various health care providers, as well as a series of postoperative follow-up appointments. In addition, regular and intense postoperative physical therapy significantly improve outcomes.^{10,11} Although surgery itself is costly, the added financial burden associated with perioperative care can make appropriate rehabilitation unaffordable for individuals with low incomes—especially when factoring in travel expenses and missed wages for time away from work. Therefore, a patient's ability to adhere to a postoperative protocol is largely dependent on their resources, which may be highly variable.^{12,13}

Minimal evidence exists in the orthopaedic literature regarding socioeconomic factors and outcomes. Some studies have found that insurance status significantly affects access to care,^{14,15} whereas another study found

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The authors report no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received February 13, 2023; accepted July 27, 2023.

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<https://doi.org/10.1016/j.asmr.2023.100791>

insurance did not affect patient status at initial presentation.¹⁶ These orthopaedic studies focus on initial access to care as a primary outcome rather than post-operative, patient-reported clinical outcomes measures, which may ultimately provide a more comprehensive understanding of the effect of socioeconomic status. The purpose of this study was to evaluate the effects of socioeconomic factors on the operative treatment of anterior cruciate ligament (ACL) injuries and outcomes following surgical reconstruction. We hypothesized that lower education levels, lower income levels, and insurance coverage from Medicaid would adversely affect outcomes.

Methods

This retrospective cohort study was approved by the institutional review board (study # 119-01430). A retrospective query was performed using relevant Current Procedural Terminology codes to identify all ACLRs performed at a single institution from March 2011 through December 2015. Inclusion criteria were patients who underwent primary ACLR with either allograft or autograft, had 2-year follow-up (including clinic visit and physical examination), and a willingness to complete a phone interview related to socioeconomic status. Exclusion criteria were patients younger than 18 years of age, multiligament repair or reconstruction, systemic diseases (inflammatory conditions, connective tissue disorders, malignancies), or surgery covered by workers' compensation due to a known association with worse outcomes.¹⁷

A retrospective chart review was performed to extract demographic and surgical data. Demographic data included age, sex, body mass index, and insurance. Insurance status was identified and classified as either Medicaid or non-Medicaid (all other types). All patients in the non-Medicaid group had private insurance. Surgical cases for both the Medicaid- and non-Medicaid-insured patients were performed by the same group of surgeons with similar techniques during the same time frame. Clinical outcomes were assessed with postoperative International Knee Documentation Committee (IKDC) scores. The IKDC score is a validated and reliable subjective patient-reported outcomes measure¹⁸ and is reported to be one of the most accurate at quantifying quality of life for patients with ACL injuries. It is also reported to be the most responsive to changes in function following surgical procedures.^{19,20} IKDC scores range from 0, representing the worst knee function and most severe symptoms, to 100, representing the best knee function and lack of symptoms.

The primary outcome of this study was the difference in mean IKDC functional score at the time of follow-up between patients with Medicaid insurance and patients with non-Medicaid insurance.

Cases were performed by 1 of 13 sports medicine fellowship-trained surgeons. Patients were not excluded based on specific surgical techniques or type of graft used. All patients were provided with standardized postoperative physical therapy guidelines. Patients were allowed to bear weight as tolerated immediately following surgery with their knee in a hinged brace locked in extension. After 1 week, the brace was unlocked to allow full active and passive range of motion. Physical therapy was initiated during the first postoperative week, focusing on heel slides and straight-leg raises with the knee in the brace. At 4 weeks, the brace was discontinued, and exercises progressed to closed chain movements. Straight line running was allowed at 3 months and gradual return to sport activity at 8 months after surgery.

Subjective knee function at the time of final follow-up between patients in the Medicaid group and patients in the non-Medicaid group was compared using the patient acceptable symptom state (PASS), which establishes a threshold value for a given patient-reported outcome measure beyond which the patient considers themselves to be doing well and is satisfied with the treatment. For IKDC, a value of 75.9 has been established as the PASS threshold for patients who underwent ACLR.²¹ Therefore, in order to compare clinically significant differences in knee function, the proportion of patients with IKDC scores greater than or equal to 75.9 at the time of follow-up was compared between groups.

All patients who were determined to be potentially eligible for inclusion were contacted to complete a telephone survey. Patients were asked to report their annual income in 1 of 5 brackets (less than \$35,000; \$35,000 to \$70,000; \$70,001 to \$105,000; \$105,001 to 200,000; greater than \$200,000) and highest education level completed. Education was divided into 4 categories: no high school degree/GED, high school degree/GED, bachelor's degree, and graduate degree.

A power analysis based on IKDC was calculated using standard deviation of 11 and group means of 87 (patients in top 10% of socioeconomic status) and 80 (patients in bottom 10% of socioeconomic status) based on a recent paper by Jones et al.²² evaluating neighborhood socioeconomic status on ACLR. Setting alpha to 0.05, and beta at 0.2 (80% power), we determined we would need 39 patients in each cohort.

Statistical analysis was performed using R (R Foundation for Statistical Computing, Vienna, Austria). Comparisons between the Medicaid and non-Medicaid groups were performed using *t*-tests for continuous variables and χ^2 or Fisher exact tests for categorical variables as appropriate. Analysis of variance was used to evaluate differences in IKDC scores across income brackets. Multivariable linear regression was used to evaluate the association between the insurance and IKDC

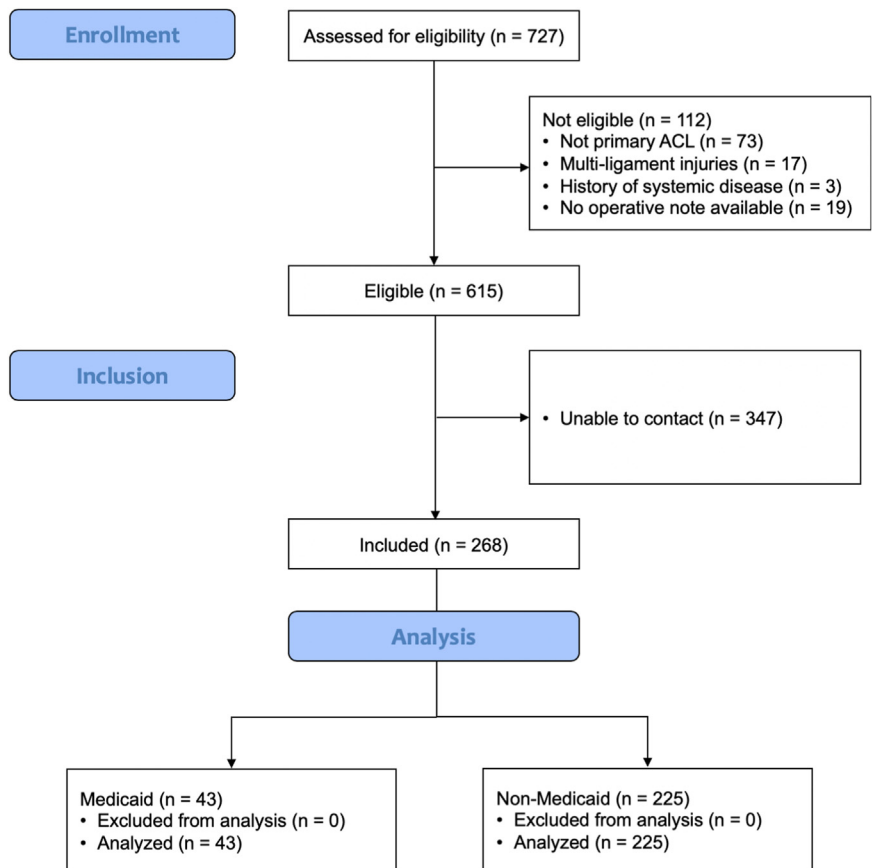


Fig 1. Flow of patients through the study. (ACL, anterior cruciate ligament.)

while controlling for confounding factors. Similarly, multivariable logistic regression was used to assess the association between insurance and odds of meeting the IKDC PASS threshold while controlling for confounding factors. For all analyses, P values less than .05 were considered statistically significant.

Results

Our initial query yielded 727 patients, who were then assessed for eligibility (Fig 1). In total, 112 patients were determined to be ineligible for study inclusion. Of the 615 eligible patients, 268 patients (43.6%) were able to be reached by telephone and were included in the study.

Forty-three patients (16.0%) had Medicaid during the study duration and 225 patients (84.0%) had non-Medicaid insurance. The mean age for all patients was 31.9 ± 10.2 years. The mean age for patients in the Medicaid group was significantly lower than the non-Medicaid group (27.0 ± 10.1 vs 32.8 ± 9.9 , $P < 0.001$). There was no difference in sex or body mass index between Medicaid and non-Medicaid groups (Table 1). The mean follow-up duration for all patients included in this study was 3.1 ± 0.8 years. There was no difference in follow-up duration between groups.

There was a statistically significant difference in income between groups ($P < .001$), with a greater percentage of patients in the Medicaid group reporting incomes in the lowest 2 annual income groups (Table 1). A statistically significant difference also existed in the highest level of education completed between groups ($P < .001$). In the Medicaid group, 60.5% of patients reported a high school degree or lower as the highest level of completed education compared with 4.5% of patients in the non-Medicaid group ($P < .001$).

Patients in the Medicaid group reported a significantly greater duration between time of initial knee injury and time of surgery compared with the non-Medicaid group (11.8 ± 16.3 months vs 6.1 ± 16.5 months, $P = .044$). There was no significant difference in graft type (autograft or allograft) between insurance groups. A greater percentage of patients who receive Medicaid (74.4%) underwent a concomitant meniscus procedure at the time of ACLR compared with patients who not receive Medicaid (57.3%), although this did not reach statistical significance ($P = .054$). There was also no statistically significant difference in the proportion of patients who underwent meniscus repair versus meniscectomy between insurance groups (Table 1).

Table 1. Comparison of Non-Medicaid and Medicaid Groups

	Non-Medicaid	Medicaid	<i>P</i> Value
n (%)	225 (84.0%)	43 (16.0%)	
Follow-up duration, y	3.1 ± 0.7	2.9 ± 0.8	.123
Age, y	32.8 ± 9.9	27.0 ± 10.1	.001
Female, n (%)	83 (36.9%)	14 (32.6%)	.713
BMI	25.8 ± 4.2	26.5 ± 4.9	.339
Symptomatic duration, mo	6.1 ± 16.5	11.8 ± 16.3	.044
Income, \$/y			<.001
0-35,000	15 (6.7%)	25 (58.1%)	
35,000-70,000	37 (16.4%)	14 (32.6%)	
70,000-105,000	45 (20.0%)	4 (9.3%)	
105,000-200,000	70 (31.1%)	0 (0.0%)	
>200,000	58 (25.8%)	0 (0.0%)	
Education			<.001
Less than high school	7 (3.1%)	4 (9.3%)	
High school	30 (1.4%)	22 (51.2%)	
Undergraduate	108 (48.0%)	14 (32.6%)	
Graduate	80 (35.6%)	3 (7.0%)	
Graft type			.643
Autograft	151 (67.1%)	31 (72.1%)	
Allograft	74 (32.9%)	12 (27.9%)	
Concomitant meniscus procedure			.083
None	96 (42.7%)	11 (25.6%)	
Meniscectomy	89 (39.6%)	20 (46.5%)	
Meniscus repair	40 (17.8%)	12 (27.9%)	
IKDC at follow-up	82.5 ± 13.8	75.3 ± 20.8	.034
IKDC ≥ PASS (%)	171 (76.0%)	25 (58.1%)	.026
Failure (%)	11 (4.9%)	3 (7.0%)	.477

NOTE. Values are shown as n (%) or mean ± standard deviation. *P* values in bold are statistically significant.

BMI, body mass index; IKDC, International Knee Documentation Committee; PASS, patient acceptable symptom state.

Effect of Insurance on Postoperative Function

At the time of follow-up, patients in the non-Medicaid group had a significantly greater IKDC score compared with patients in the Medicaid group (82.5 ± 13.8 vs 75.3 ± 20.8, *P* = .034). Furthermore, a significantly greater proportion of patients in the non-Medicaid group met the IKDC PASS threshold compared with patients in the Medicaid group (76.0% vs 58.1%, $\chi^2 = 4.987$, *P* = .026). There was no significant correlation between the duration from injury to surgery and IKDC (*r* = 0.01, *P* = .875). There was no significant difference in failure rate between groups (Table 1).

When we controlled for age, education, graft type, concomitant meniscus procedure, and the duration between injury and surgery, multiple linear regression demonstrated that having Medicaid insurance was associated with significantly worse functional outcomes compared with non-Medicaid insurance. When holding the other variables constant, Medicaid insurance was associated with an 8-point decrease in IKDC score at the time of follow-up (95% confidence interval −13.28 to −2.82, *P* = .004). Similarly, based on multivariable logistic regression, Medicaid insurance was associated with a lower likelihood of achieving IKDC PASS

threshold at follow-up (odds ratio [OR] = 0.46, 95% confidence interval [CI] 0.22-0.98, *P* = .042).

Effect of Income on Postoperative Function

There was a significant difference in IKDC scores at the time of follow-up between income bracket groups (*F* = 3.21, *P* = .013). Post-hoc analysis revealed that the highest income group (> \$200,000) had greater mean IKDC scores than each of the lower income groups. Similarly, the highest-income group had a significantly greater proportion of patients meeting the IKDC PASS threshold (86.2%) compared with the 3 lowest-income groups (67.3% of the \$70,000-\$105,000 group, $\chi^2 = 4.400$, *P* = .036; 66.7% of the \$35,000-\$70,000 group, $\chi^2 = 4.809$, *P* = .028; 62.5% of the <\$35,000 group, $\chi^2 = 6.147$, *P* = .013). There was no difference between the 2 highest income groups (86.2% vs 77.1%, $\chi^2 = 1.167$, *P* = .280).

When we controlled for age, education, graft type, concomitant meniscus procedure, and the duration between injury and surgery, multiple linear regression demonstrated that the highest-income bracket was associated with a significant increase in IKDC score compared with the lowest-income brackets (*P* = .004). The highest-income bracket (>\$200,000) was

associated with a 12-point increase in IKDC score when holding the other variables constant (95% CI 5.31-19.10, $P < .001$). Based on multivariable logistic regression, the highest-income bracket was associated with greater likelihood of achieving IKDC PASS threshold at follow-up (OR = 3.95, 95% CI 1.24-13.32, $P = .022$).

Discussion

Patients who receive Medicaid have longer intervals between time of injury and surgery compared with patients with non-Medicaid coverage and worse postoperative subjective knee function compared with patients with non-Medicaid coverage. In addition, patients with lower incomes have lower postoperative IKDC scores compared with patients with higher incomes. The results of this study therefore suggest that socioeconomic status plays a role in patient outcome following ACLR.

Socioeconomic status is a complex amalgamation of variables; however, several components are relevant to health care outcomes in nonorthopaedic fields. Shah et al.²³ found health insurance status significantly affected outcomes in the fields of medicine and general surgery. Another study reported greater education level as an independent positive prognostic factor for improved survival in esophageal cancer surgery.²⁴ Income level affects the rate at which patients seek health care, with one study finding patients in low-income brackets with mitral regurgitation less likely to pursue mitral valve repair.²⁵ Patients with low income have significantly lower rates of stoma closure following ostomy. This discrepancy was attributed to a lack of access to proper care and follow-up.²⁶

To examine the potential detriment of being socioeconomically disadvantaged requires definitional clarity. Patients with Medicaid health care insurance had lower income and would therefore meet the criteria of being socioeconomically disadvantaged. An analysis of the cohort demonstrated that patients with Medicaid insurance did in fact have significantly lower annual income levels and levels of education than the non-Medicaid group. The Medicaid group was significantly younger when compared with the non-Medicaid group. However, there were no other demographic differences between the 2 groups.

This study suggests that there are quantifiable differences among groups with varying socioeconomic status who undergo primary ACLR. The current literature would suggest lower socioeconomic status leads to poorer surgical outcomes.²⁷ Similar results were found in the aforementioned study by Jones et al.,²² although this study used a slightly different approximation of socioeconomic status based on the neighborhoods in which patients lived. Consistent with this sentiment,

data from this study found the non-Medicaid cohort had greater functional scores than the Medicaid group.

Expediency of care was significantly lower in the Medicaid group, which is consistent with previous investigations demonstrating delays in initial presentation in underinsured patients.²⁸ Patients who receive Medicaid waited, on average, 5.2 months longer than those with other insurance types from the time of initial injury to surgery. A likely explanation for this finding is access to care. A recent study found that when calling to make a follow-up appointment from an emergency department visit for diagnosis of ankle fracture, patients who received Medicaid were 5.7 times less likely to successfully book an appointment at orthopaedic practices than those with private insurance or those who were completely uninsured.²⁹ This suggests that patients with Medicaid coverage may be at a significant disadvantage in the context of initially finding orthopaedic care. Alternatively, this may reflect the difficulty of being able to take time away from work to seek medical care for patients with worse socioeconomic status.

Although time to surgery was significantly affected by insurance payer, this difference did not significantly affect outcomes based on IKDC. These findings support those of Manandhar et al.,³⁰ who reported no difference in terms of range of motion and functional outcomes between early and delayed ACLR at 6-month follow-up. To explain the discrepancy between their findings and those of others that found greater rates of arthrofibrosis in those who underwent early ACLR, the authors claim to have superior uniformity with respect to surgical technique, graft material, fixation devices, rehabilitation protocols, and outcomes measures lacking in the Shelbourne study.³¹ Hunter et al.³² also reported that restoration of high levels of motion and stability at 12 months' postoperatively was independent of surgical timing. The consistency of our findings with the orthopaedic literature suggests that if state-provided health insurance does cause delayed surgery, it does not impact long-term outcomes in ACLR.

While IKDC outcomes may not be affected by time to surgery, that does not mean delayed intervention has no effect on patient well-being. Salci et al.³³ found that patients living with ACL injury reported a negative impact on physical and emotional health, thereby negatively impacting quality of life. Poorer access to care for patients with socioeconomic challenges has been identified repeatedly in the literature, citing lower appointment availability for patients who receive Medicaid, lack of follow-up appointment scheduling, and greater negotiated rates for the uninsured.^{29,34} This association of poor access to health care and lower quality of life should prompt surgeon consideration and spur possible intervention.

In addition, although it did not reach significance, the delay in care between the Medicaid and non-Medicaid groups likely explains the greater proportions of meniscal procedures needed in the Medicaid group. It is possible that these patients will be subject to accelerated cartilage degeneration compared with the non-Medicaid group, and an even greater discrepancy in outcomes could exist at 5 to 10 years of follow-up.

Income level significantly impacted IKDC 2 years after surgery. This finding is consistent with Kugelman et al.'s report²⁷ of patients with lower income levels having worse functional outcomes following fracture nonunion repair. With the importance of clinical follow-up and physical therapy rehabilitation following ACL surgery well-documented, it is important to understand how barriers to proper rehabilitation materialize in low-income patient populations. It is reasonable to believe that patients with socioeconomically challenges may have difficulty traveling to appointments or may be more acutely affected by missing work and thus less likely to adhere to recommended follow-up appointments and therapy regimens. In addition, these patients may also be unable to limit their physical activity if working in a labor-intensive job.

Problems like these are complex and systemic, but measures can be taken to help alleviate some of these challenges. These results should encourage physicians to take socioeconomic factors into consideration when discussing surgery with a patient who receives Medicaid and set-up a care plan to work within the confines of the patient's more limited financial abilities. Patients with Medicaid tend to have more complex social stresses that may result in a decreased propensity to seek care and attend important follow-up sessions.³⁴ Providers must be aware of a patient's socioeconomic status and plan follow-up appointments accordingly. Physicians should spend extra time discussing warning signs with patients they believe are unlikely to be able to come in regularly and provide these patients with specific criteria for when they must see a health care provider in addition to providing rehabilitation guidance like home exercise protocols in case patients cannot attend postoperative physical therapy. Although this should be done with all patients, additional emphasis should be placed with patients with socioeconomically challenges. Larger hospitals can encourage physicians to spend time at satellite clinics in less economically fortunate areas, facilitating patient contact and easing the travel burden on their patients. Increased insurance coverage of specialist care could also open doors for greater access for lower socioeconomic status patients.³⁵ Awareness of the disparity and adapting to

different patients' needs is the first step towards minimizing the disparities we see today.

Limitations

This study is based primarily on subjective data obtained from patients via telephone survey and is subject to the inherent limitations and biases associated with obtaining information through telephone interview. In addition, although the patients at our institution are provided with standardized postoperative physical therapy guidelines, we were unable to verify that all patients were compliant with the protocol. Furthermore, due to individual differences in insurance plans, even within the private insurance group, the number of physical therapy sessions completed was not the same across the cohort. Private insurance plans and higher income may have allowed for a greater number of postoperative physical therapy sessions, which may further explain the underlying associated between socioeconomic factors and postoperative outcomes.

We have a disproportionately small number of patients in the Medicaid group as a result of the overall patient population seen at our institution, which could create further bias. Lastly, this study was performed at a large, urban academic institution. The results may not be generalizable to all practice settings.

Conclusions

Patients with Medicaid insurance were seen in the clinic significantly later after initial injury and had worse outcomes compared with patients with other insurance types. Also, patients in greater annual income brackets had significantly better clinical outcomes scores at a minimum of 2 years postoperatively.

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