THE EUROPEAN SOCIETY OF MEDICINE
Medical Research Archives, Volume 13 Issue 10

REVIEW ARTICLE

Insurance and Socioeconomic Disadvantage in Patients with Multiligament Knee Injury: Associations with Demographics, Mechanism, and Severity

Cody T McGrale, BS[1]; Collin D.R. Hunter, BS[1]; Joseph Featherall, MD[1]; Patrick Greis, MD[1]; Travis G. Maak, MD[1]; Stephen K. Aoki, MD[1]; Antonio Klasan, MD[2]; Justin J. Ernat, MD[1]

[1] Department of Orthopaedics, University of Utah, Salt Lake City, Utah, USA.
[2] AUVA UKH Steiermark, Department of Orthopaedics and Traumatology, Graz, Austria.

OPEN ACCESS

PUBLISHED
31 October 2025

CITATION
McGrale, CT., Hunter, CDR., et al., 2025. Insurance and Socioeconomic Disadvantage in Patients with Multiligament Knee Injury: Associations with Demographics, Mechanism, and Severity. Medical Research Archives, [online] 13(10).
https://doi.org/10.18103/mra.v13i10.7007

DOI
https://doi.org/10.18103/mra.v13i10.7007

ISSN
2375-1924

ABSTRACT

Background: Multiligament knee injuries are complex injuries frequently complicated by vascular and nerve injuries involving the tibiofemoral joint resulting from a multitude of mechanisms. By definition, they must involve partial or complete tear of ≥2 of the 4 major knee ligaments. Beyond injury mechanism, social determinants of health have an established influence on orthopedic outcomes, but an association has not been investigated between multiligament knee injuries and these social factors.

Aims: To analyze demographic profiles, insurance types, and area deprivation scores to determine if a correlation could be found between socioeconomic status and injury severity (polytrauma vs non-polytrauma) and mechanisms (high energy vs low energy) leading to multiligament knee injuries.

Methods: This is a retrospective review of multiligament knee injury patients surgically treated at a single institute. Sociodemographic information, clinical records, and surgical reports were collected. Insurance types were stratified into private, public (Medicaid/Medicare), or other (workers' comp, auto, charity, uninsured), and area deprivation index was collected using patient addresses. Patients with insufficient records were excluded from the study. Subgroup analyses were done on sex, age, body mass index, polytrauma status, and high energy versus low energy mechanism.

Results: A total of 218/264 patients (82%) with multiligament knee injuries were eligible. 70% were privately insured, 21% had public insurance, and 9% had other insurance. Private insurance mean age was 27.6, public 28.4, and other 36.2 (P=0.021). Private insurance had a mean body mass index of 27.2 versus 30.9 for public and 32.8 for other (P=<0.001). Area deprivation score percentile was significantly different: 29.1 private versus 39.6 public versus 38.8 other (P=0.002). Public insurance (B, +8.93; p=0.006) and other insurance (B, +10.04; p=0.030) were independently associated with area deprivation score. Only high energy injury mechanism (OR, 87.83; p=<0.001) was associated with polytrauma. Male sex (OR 3.67; p=0.005), age (OR, 1.05; p=0.003), and polytrauma (OR, 94.44; p=<0.001) were associated with high energy mechanism.

Conclusion: Socioeconomic disadvantage, defined by insurance type and area deprivation score, was associated with demographic differences but did not predict high energy mechanism or polytrauma status in multiligament knee injury patients. These findings reinforce that multiligament knee injury severity is linked to biomechanical and demographic factors rather than social factors.

Key Terms: Knee, knee ligaments, multiligament injuries, socioeconomic status, health disparities

Study design: Cross-sectional study; Level of evidence, 3.

Introduction

Multiligament knee injuries (MLKIs) are complex injuries frequently complicated by vascular and nerve injuries involving the tibiofemoral joint resulting from a multitude of mechanisms.[1,2,3] By definition, a MLKI must involve partial or complete tear of ≥2 of the 4 major knee ligaments (ACL, PCL, MCL, LCL).[4] These are not common orthopedic injuries as they have an incidence of 0.02% to 0.20%[5], and they typically require complex surgical strategies. MLKIs tend to have inferior patient reported outcomes[6,7] with a high burden of complications and reoperations.[8] Long term outcomes remain limited, with many patients experiencing continued instability, stiffness, or functional deficits.[9,10] Mechanism of injury has shown to create distinct ligament injury patterns with high energy mechanism (e.g., motor vehicle collision, high impact fall) and polytrauma showing a higher rate of PCL and LCL injuries when compared to lower injury mechanism (e.g., sports, ground level fall) and non-polytrauma patients.[1]

Beyond injury mechanism, social determinants of health have an established influence on orthopedic outcomes in settings such as isolated ACL reconstruction (ACLR), pediatric knee injuries, and rotator cuff repair. Insurance status, roughly categorized as private, public (Medicaid/Medicare), or other (e.g., workers' compensation, uninsured, charity), is often used as a proxy for socioeconomic status. Area Deprivation Index (ADI) is a validated neighborhood level measure that ranks neighborhoods from least to most disadvantaged from 1-100 using income, education, employment, and housing quality.[11] Both of these have been linked to disparities across orthopedics. For example, patients with Medicaid getting ACLR have significantly lower postoperative International Knee Documentation Committee (IKDC) score (74.7 vs 90.5, p=0.05).[12] Additionally, patients from more disadvantaged neighborhoods have significantly higher rates of medical complications (10.84% vs 9.45%, p=0.005) and higher care costs at the day of surgery ($8251 vs $7337) and at 90 days ($10,999 vs $9752) (p=<0.001).[13]

Access and timing of care play a large role in outcomes for patients, and Medicaid insurance is consistently linked with longer delays from injury to clinic/surgery, along with worse 2-year outcomes than non-Medicaid patients after isolated ACL reconstruction.[14] Higher ADI has also been shown to be associated with longer delays to care and increased risk of reinjury after ACLR.[15] Patient reported outcomes similarly are affected by Medicaid as lower postoperative IKDC scores and return to sport rates have been reported in these patients when compared to commercially insured peers.[12]

Socioeconomic disparities have also been documented in other fields of orthopedics. Insurance type and neighborhood disadvantage predict not only access and timing of care, but also length of stay, readmission, and complication rates after joint arthroplasty.[16,17] In trauma socioeconomic inequity is a consistent risk factor for increased complication rate and resource utilization.[18] While socioeconomic disadvantages have been shown to reliably affect who gets seen, how fast, and surgical outcomes across orthopedic domains, the impact of these factors, such as insurance status and ADI, on injury mechanism or severity remains not as clear.

The objective of this study was to analyze demographic profiles, insurance types, and ADI scores to determine if a correlation could be found between socioeconomic status and injury severity (polytrauma vs non polytrauma) and mechanisms (high energy vs low energy) leading to MLKI. We hypothesized that lower socioeconomic status and higher ADI would be associated with higher energy mechanisms and polytrauma as compared to higher socioeconomic status.

Methods

PATIENT SELECTION AND CLINICAL CHARACTERISTICS

This is a retrospective review of MLKI patients surgically treated with at least 2 ligamentous reconstructions or repairs at a tertiary academic medical center from April 2008 to October 2024. The primary inclusion and exclusion criteria framework has been reported previously.[1] For the present study, additional requirements included documentation of insurance and residential address at the time of the injury. Patients were included if they (1) were diagnosed with MLKI with at least 2 ligamentous injuries, ACL, MCL, PCL, and/or LCL managed surgically, (2) had available records of the mechanism that led to MLKI, (3) had documentation of sociodemographic information, and (4) had accessibility to the operative note. Patients were excluded if they had any revision MLKI surgery, underwent nonoperative management or arthroplasty, or if they were deemed chronic MLKI (> 1 year from injury to surgery). Patients with MLKIs were located by assessing surgeon operative notes where ≥2 of the ACL, MCL, PCL, and/or LCL managed surgically through either repair or reconstruction. Demographic factors such as age, sex, body mass index (BMI), insurance status, and provider, residential address were obtained through chart review using an electronic medical record (Epic; Epic Systems Corporation). Clinical data were collected and kept in a longitudinal Research Electronic Data Capture (REDCap; Vanderbilt University) database.

CLASSIFICATIONS OF MECHANISMS

Patients with MLKIs were categorized based on the injury mechanism to sort the mechanism severity: polytrauma or non-polytrauma, and high energy or low energy. Polytrauma MLKIs had additional injuries to the head, spine, extremities, abdomen, and/or pelvis. Non-polytrauma MLKIs only had traumatic injuries to the knee joint. High energy MLKIs result from substantial external forces like motor vehicle crashes or falls from over 1.5 m, and low energy MLKIs are from less severe forces such as sports injuries or ground-level falls.[19]

CLASSIFICATION OF INSURANCE AND AREA DEPRIVATION INDEX

Patients with MLKIs were classified based on their insurance at the time of injury to sort them into 3 categories: Private, Public (Medicaid or Medicare), or Other (workers' comp, auto, charity, uninsured). Socioeconomic disadvantage was assessed using ADI as a proxy, and patient residential addresses at the time of

injury were used in the ADI database to obtain a national census percentile (1 = least disadvantaged; 100 = most disadvantaged).[11]

STATISTICAL ANALYSIS

Data was exported from REDCap database and put into SPSS Version 27 statistical software (IBM Corp). One-way ANOVA was used for continuous variables comparisons, and chi-square analysis for categorical variable comparisons. Three regression models were used to quantify a relationship between our variables: multiple linear regression with ADI as the dependent variable, binary logistic regression with polytrauma status as the dependent variable, and binary logistic regression with energy status as the dependent variable. Statistical significance was set at $P < 0.05$.

Results

DEMOGRAPHICS AND INSURANCE/AREA DEPRIVATION INDEX

After performing a search with inclusion/exclusion criteria applied, a total of 218/264 patients (82%) with MLKIs were eligible for the study. In this group, 70% were privately insured, 21% had public insurance, and 9% had other insurance (workers' comp, auto, charity, uninsured). Private insurance mean age was 27.6 (range, 5-66; SD, 13.4), public insurance mean age was 28.4 (range, 12-57; SD, 11.2), and other insurance mean age was 36.2 (range, 18-57; SD, 12.0) (P=0.021). Private insurance had a mean BMI of 27.2 (SD, 6.8) versus 30.9 (SD, 8.4) for public versus 32.8 (SD, 11.3) for other (P=<0.001) (Figure 1). The sex distribution was not significantly different, with private having 71.1% male (108/152), public 65.2% male (30/46), and other 80.0% (16/20) male (P=0.470). ADI percentile was significantly different between the 3 insurance groups: 29.1 (SD, 18.6) private versus 39.6 (SD, 19.7) public versus 38.8 (SD, 22.1) other (P= 0.002) (Table 1).

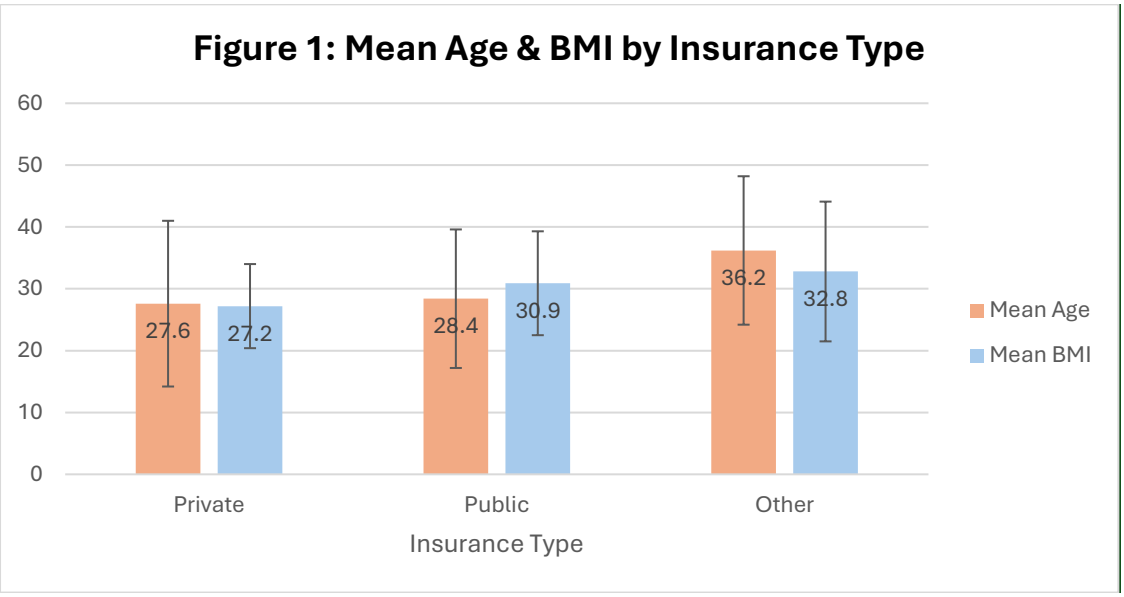

Figure 1. Bar Chart of mean age and body mass index (BMI) by insurance type with standard deviation error bars. Age ($p = 0.021$) and BMI ($p < 0.001$) differed significantly across insurance groups (one-way ANOVA).

Table 1: Demographics by Insurance Type

	Private (n=152)	Public (n=46)	Other (n=20)	P- Value
Age (years)	27.6 ± 13.4	28.4 ± 11.2	36.2 ± 12.0	**0.021**
Sex (Male)	108 (71.1%)	30 (65.2%)	16 (80.0%)	0.470
BMI	27.2 ± 6.8	30.9 ± 8.4	32.8 ± 11.3	**<0.001**
ADI percentile	29.1 ± 18.6	39.6 ± 19.7	38.8 ± 22.1	**0.002**

Abbreviations: ADI = Area Deprivation Index; BMI = body mass index.
Data is presented as mean ± standard deviation or n (%). Bolded p-values indicate statistical significance at $p < 0.05$. Comparisons were made using one-way ANOVA for age and ADI, Welch's ANOVA with Games–Howell post hoc for BMI (due to heterogeneity of variance), and chi-square test for sex.

ADI was stratified into quartiles, and 39% of patients fell in Q1 (least disadvantaged, 1st–24th percentile), 44% in Q2 (25th–49th), 12% in Q3 (50th–74th), and 5% in Q4 (most disadvantaged, 75th–100th percentile) (Figure 2). Age was similar across quartiles (Q1: 29.4 years; Q2: 28.1; Q3: 27.7; Q4: 28.7; P = 0.911), as was body mass index (BMI) (Q1: 26.7; Q2: 29.3; Q3: 29.4; Q4: 32.2; P = 0.050). The sex distribution was not significantly different across quartiles (Q1: 70.6% male, Q2 71.9% male, Q3 63.0% male, and Q4 80.0% male; P = 0.739). Insurance type was significantly different between the 4 quartiles with 82.4% private in Q1, 66.7% private in Q2, 48.1% private in Q3, and 50.0% private in Q4 (P= 0.019) (Table 2).

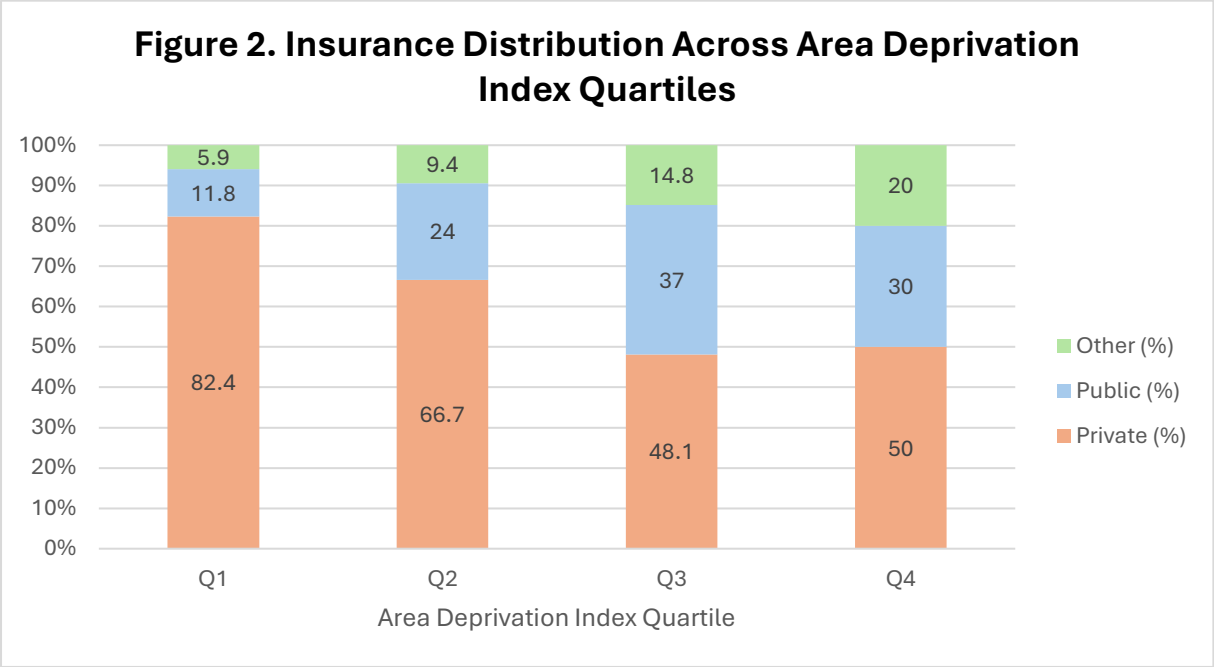

Figure 2. Stacked bar chart of distribution of insurance type across Area Deprivation Index quartiles. Bars represent the proportion of patients within each quartile of neighborhood disadvantage (Q1 = least disadvantaged; Q4 = most disadvantaged).

Table 2: Demographics by Area Deprivation Index Quartiles

	Q1 (least deprived n=85)	Q2 (n=96)	Q3(n=27)	Q4 (most deprived n=10)	P- Value
Age (years)	29.4 ± 13.7	28.1 ± 13.5	27.7 ± 10.0	28.7 ± 10.0	0.911
Sex (Male)	60 (70.6%)	69 (71.9%)	17 (63.0%)	8 (80.0%)	0.739
BMI	26.7 ± 6.2	29.3 ± 9.0	29.4 ± 7.9	32.2 ± 5.8	0.050
Insurance Type:					**0.019**
-- Private	70 (82.4%)	64 (66.7%)	13 (48.1%)	5 (50.0%)	
-- Public	10 (11.8%)	23 (24.0%)	10 (37.0%)	3 (30.0%)	
-- Other	5 (5.9%)	9 (9.4%)	4 (14.8%)	2 (20.0%)	

Abbreviations: BMI = body mass index.
Data are presented as mean ± standard deviation or n (%). Bolded p-values indicate statistical significance at $p < 0.05$. Comparisons were made using one-way ANOVA for age and BMI, and chi-square tests for categorical variables (sex, insurance type).
ADI quartiles: Q1= 1-24, Q2= 25-49, Q3= 50-74, and Q4= 75-100

INSURANCE AND AREA DEPRIVATION INDEX WITH MECHANISM AND TRAUMA STATUS ANALYSIS

Multiple linear regression with ADI as the dependent variable was used, with unstandardized regression coefficients (B) reported. Public insurance (B, +8.93; p=0.006) and other insurance (B, +10.04; p=0.030) were independently statistically associated with ADI percentile. Male sex (-0.57; p=0.846), age (B, -0.10; p=0.317), high energy injury mechanism (B, +2.79; p=0.420), and polytrauma status (B, +4.99; p=0.189) were not significantly associated with ADI percentile (Table 3).

Table 3. Multiple Linear Regression Predicting Area Deprivation Index Percentile

Predictor	B (95% CI)	P- Value
Insurance Type:		
-- Private	0 (ref)	-
-- Public	+8.93 (2.56-15.30)	**0.006**
-- Other	+10.04 (0.97- 19.12)	**0.030**
Sex (male)	-0.57 (-6.39 to 5.25)	0.846
Age	-0.10 (-0.31 to 0.10)	0.317
High Energy Injury Mechanism	+2.79 (-4.02 to 9.60)	0.420
Polytrauma	+4.99 (-2.47 to 12.45)	0.189

Data are presented as unstandardized coefficients (B) with 95% confidence intervals. Bolded p-values indicate statistical significance at $p < 0.05$.
$R^2 = 0.081$, adjusted $R^2 = 0.054$, $F(6,208) = 3.04$, $p = 0.007$

A binary logistic regression with polytrauma status as the dependent variable was also run. Only high energy injury mechanism (OR, 87.83; p=<0.001) was significantly associated with polytrauma status. Public insurance (OR, 1.55; p=0.402), other insurance (OR 0.58; p=0.410), male sex (OR, 0.97; p=0.950), age (OR, 0.98; p=0.216), and ADI percentile (OR, 1.01; p=0.274) were not associated with polytrauma (Table 4).

Table 4. Logistic Regression Predicting Polytrauma in Multiligament Knee Injury Patients

Predictor	OR (95% CI)	P- Value
Insurance Type:		
-- Private	1.00 (ref)	-
-- Public	1.55 (0.56–4.27)	0.402
-- Other	0.58 (0.16–2.10)	0.410
Sex (male)	0.97 (0.34–2.72)	0.950
Age	0.98 (0.95–1.01)	0.216
ADI percentile	1.01 (0.99–1.03)	0.274
High Energy Injury Mechanism	87.83 (19.74–390.81)	**<0.001**

Abbreviations: ADI = ADI = Area Deprivation Index; OR = odds ratio; CI = confidence interval.
Data are presented as odds ratios with 95% confidence intervals. Bolded p-values indicate statistical significance at $p < 0.05$.
Model fit: Nagelkerke $R^2 = 0.547$; $\chi^2(6) = 100.6$, $p < 0.001$; Hosmer–Lemeshow $p = 0.325$

Another binary logistic regression was run, but with high energy mechanism as the dependent variable. Male sex (OR 3.67; p=0.005), age (OR, 1.05; p=0.003), and high energy mechanism (OR, 94.44; p=<0.001) were all found to be associated with high energy injury mechanism. Public insurance (OR, 0.93; p=0.876), other insurance (OR, 1.69; p=0.376), and ADI percentile (OR, 1.01; p=0.345) were all not statistically associated with high energy mechanism (Table 5).

Table 5. Logistic Regression Predicting High-Energy Mechanism in Multiligament Knee Injury Patients

Predictor	OR (95% CI)	P- Value
Insurance Type:		
-- Private	1.00 (ref)	-
-- Public	0.93 (0.35–2.45)	0.876
-- Other	1.69 (0.53–5.41)	0.376
Sex (male)	3.67 (1.48–9.10)	**0.005**
Age	1.05 (1.02–1.08)	**0.003**
ADI percentile	1.01 (0.99–1.03)	0.345
High Energy Injury Mechanism	94.44 (20.72–430.39)	**<0.001**

Abbreviations: ADI = Area Deprivation Index; OR = odds ratio; CI = confidence interval.
Data are presented as odds ratios with 95% confidence intervals. Bolded p-values indicate statistical significance at $p < 0.05$.
Nagelkerke $R^2 = 0.554$; $\chi^2(6) = 115.0$, $p < 0.001$; Hosmer–Lemeshow $p = 0.122$

Discussion

This retrospective review was looking to find a correlation between the socioeconomic status of patients with MLKIs, using insurance type and ADI as a proxy, and injury mechanism and severity. Socioeconomic status was associated with baseline demographic differences but did not predict injury mechanism or energy. Patients who had public insurance or other insurance (workers' comp, auto, charity, uninsured) had higher BMI, were older at the time of surgery, and came from more disadvantaged neighborhoods as compared to patients who were privately insured. Neither ADI nor insurance type were independently associated with high energy mechanisms or polytrauma patients. Instead, polytrauma was almost exclusively caused by high energy mechanism injuries, while high energy injuries were also associated with male sex, older age, and polytrauma. These findings extend prior work from our MLKI patient cohort, which demonstrated that high energy and polytraumatic mechanisms produce distinct ligament involvement, with high energy and polytrauma more likely to involve the PCL and LCL.[1] That study was important for highlighting the importance that biomechanical factors play in dictating MLKI morphology. This study reinforced that same theme, but despite well-established associations between socioeconomic disadvantage and access to care, complications, and outcomes in orthopedics,[12,14–16,20] we found that it did not influence how MLKIs occur in either mechanism or energy.

Socioeconomic disadvantage has been studied in various aspects of orthopedics, where it consistently predicts delayed care, increased complications, and worse outcomes. Kingery et al[14] found that isolated ACLR patients with public insurance had delayed time of presentation and worse patient reported outcomes. Similarly, ACLR patients with higher ADI scores also had delayed presentations, higher reinjury rates, and worse postoperative functions.[15] Outside the knee, shoulder surgery patients were also shown to have higher rates of emergency department usage and readmission if they were from more disadvantaged neighborhoods.[13]

Arthroplasty also echoes these findings, with socioeconomic disadvantage found to be linked to increased risk of complications, increased length of stay, and worse long term functional outcomes.[21]

In contrast to these studies in other areas of orthopedics, our study found that socioeconomic status does not influence the mechanism or severity of MLKIs. This difference likely reflects the unique nature of these knee injuries. MLKIs are often emergent, trauma driven injuries where energy transfer and biomechanical forces, as opposed to social factors, determine the degree of ligamentous injury. Unlike isolated ACL injuries, which typically happen during recreational or organized sports and may be influenced by early surgical referral and access to prevention programs, MLKIs often occur suddenly and indiscriminately. The influence of social determinates of health may instead manifest in downstream aspects of care for MLKIs, such as timing of surgery, rehabilitation adherence, and/or long-term functional outcomes, but are unlikely to affect how the injury itself occurs.

This justification aligns with literature in the trauma field. A systematic review by O'Hara et al[18] showed that social factors in orthopedic trauma do not consistently predict injury mechanism, but rather influence recovery outcomes such as return to work. While the effects of social determinants emerge later in the care of these patients, the initial injury is biomechanically driven. Our findings in MLKIs share this principle that socioeconomic disadvantage is associated with demographics but not with the biomechanical severity of the injury.

Clinically, mechanisms of injury and demographics such as sex and age remain the most reliable predictors of injury severity in MLKIs. Insurance type and ADI remain important for understanding health disparities of patients, but do not add predictive value for clinicians when assessing MLKIs. Our findings reiterate the importance of having a mechanism focused approach to triage on initial evaluation. High energy mechanisms should raise concern for polytrauma and greater ligament involvement, consistent with prior literature.[1] While socioeconomic factors may not drive mechanism, they likely affect the patient's journey when recovering from their injury. Although our study did not capture the effects of insurance type and ADI on access to timely reconstruction, adherence to rehabilitation, and functional outcomes, they remain highly relevant to patient care.

Future research should investigate the downstream effects of socioeconomic disadvantage on MLKI recovery, including access to timely reconstruction, adherence to rehabilitation, and return to function. Although our data suggest socioeconomic factors do not influence the initial mechanism or severity of MLKIs, they remain highly relevant to outcomes and should be incorporated in efforts to optimize equitable care.

LIMITATIONS

This study recognizes several limitations. Its retrospective, single center design limits generalizability, and has potential biases that are inherently in historical data collection with selection biases from surgeons. While the patients were gathered from a single institution, the data was gathered by 4 separate orthopedic sports surgeons. The institution is a tertiary academic level 1 trauma center that accepts referrals from multiple states in the surrounding area. The use of insurance type and ADI as proxies for socioeconomic status may not fully capture the complexity of social determinants of health. Despite these limitations, our findings provide insights into the role of socioeconomic factors in MLKIs.

Conclusion

Socioeconomic disadvantage, defined by insurance type and ADI, was associated with demographic differences but did not predict high energy mechanism or polytrauma status in MLKI patients. These findings reinforce that MLKI severity is linked to biomechanical and demographic factors rather than social factors. While social determinants of health and disparities in access to care remain important in orthopedics, they may not shape the mechanism of trauma driven injuries like MLKIs. Future work should focus on the impact of socioeconomic disadvantages on recovery and long-term outcomes following multiligamentous reconstruction.

Conflicts of Interest Statement

TM has or may receive payments or benefits from Arthrex (other professional activities) related to this work.
SA has or may receive payments or benefits from Stryker (other professional activities) and/or HipSTR Registry (board of directors or committee member) related to this work.
JE has or may receive payments or benefits from Johnson & Johnson/Depuy (other professional activities) related to this work.
All other authors have no conflicts of interest to declare.

References

1. Hunter CDR, Featherall J, McNamara N, et al. Investigating the Ligament Involvement in High-Energy and Polytraumatic Multiligament Knee Injuries Compared with Low-Energy or Isolated Injuries. *Orthopaedic Journal of Sports Medicine*. 2025;13(2): 23259671241312251. doi:10.1177/23259671241312251
2. Levy BA, Dajani KA, Whelan DB, et al. Decision Making in the Multiligament-Injured Knee: An Evidence-Based Systematic Review. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*. 2009;25(4):430-438. doi:10.1016/j.arthro.2009.01.008
3. Fanelli GC, Orcutt DR, Edson CJ. The multiple-ligament injured knee: Evaluation, treatment, and results. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*. 2005;21(4):471-486. doi:10.1016/j.arthro.2005.01.001
4. Ng JWG, Myint Y, Ali FM. Management of multiligament knee injuries. *EFORT Open Reviews*. 2020;5(3):145-155. doi:10.1302/2058-5241.5.190012
5. Lang PJ, Feroe A, Franco H, Hussain ZB, Tepolt FA, Kocher MS. Outcomes of Operative Management of Multi-Ligament Knee Injuries in an Adolescent Population: A Retrospective Case Series. *Journal of the Pediatric Orthopaedic Society of North America*. 2023;5(4):742. doi:10.55275/JPOSNA-2023-742
6. Nielsen TG, Sørensen OG, Lind M. A comparison of multi-ligament reconstruction and isolated anterior cruciate ligament reconstruction at one year follow-up: results from the Danish Knee Ligament Reconstruction Registry. *J exp orthop*. 2022;9(1):30. doi:10.1186/s40634-022-00473-z
7. Alentorn-Geli E, Lazarides AL, Utturkar GM, et al. Factors predictive of poorer outcomes in the surgical repair of multiligament knee injuries. *Knee Surg Sports Traumatol Arthrosc*. 2019;27(2):445-459. doi:10.1007/s00167-018-5053-9
8. Cook S, Ridley TJ, McCarthy MA, et al. Surgical treatment of multiligament knee injuries. *Knee Surg Sports Traumatol Arthrosc*. 2015;23(10):2983-2991. doi:10.1007/s00167-014-3451-1
9. Klasan A, Maerz A, Putnis SE, Ernat JJ, Ollier E, Neri T. Outcomes after multiligament knee injury worsen over time: A systematic review and meta-analysis. *Knee surg sports traumatol arthrosc*. 2025;33(4): 1281-1298. doi:10.1002/ksa.12442
10. Zhang T, Shasti K, Dubina A, et al. Long-Term Outcomes of Multiligament Knee Injuries. *Journal of Orthopaedic Trauma*. 2022;36(8):394-399. doi:10.1097/BOT.0000000000002348
11. Kind AJH, Buckingham WR. Making Neighborhood-Disadvantage Metrics Accessible — The Neighborhood Atlas. *N Engl J Med*. 2018;378(26): 2456-2458. doi:10.1056/NEJMp1802313
12. Chava NS, Fortier LM, Verma N, et al. Patients With Medicaid Insurance Undergoing Anterior Cruciate Ligament Reconstruction have Lower Postoperative International Knee Documentation Committee Scores and are Less Likely to Return to Sport Than Privately Insured Patients. *Arthroscopy, Sports Medicine, and Rehabilitation*. 2022;4(4):e1457-e1464. doi:10.1016/j.asmr.2022.05.005
13. Gordon AM, Sheth BK, Conway CA, Horn AR, Sadeghpour R, Choueka J. Neighborhood Deprivation and Association with Medical Complications, Emergency Department Use, and Readmissions in Shoulder Arthroplasty Patients. *HSS Journal®: The Musculoskeletal Journal of Hospital for Special Surgery*. 2024;20(4):482-489. doi:10.1177/15563316231195299
14. Kingery MT, Kaplan D, Resad S, Strauss EJ, Gonzalez-Lomas G, Campbell KA. After Anterior Cruciate Ligament Injury, Patients with Medicaid Insurance Experience Delayed Care and Worse Clinical Outcomes Than Patients with Non-Medicaid Insurance. *Arthroscopy, Sports Medicine, and Rehabilitation*. 2023;5(5):100791. doi:10.1016/j.asmr.2023.100791
15. Cherelstein RE, Natal-Albelo EJ, Kuenze CM, et al. The Effect of Greater Area Deprivation and Medicaid Insurance Status on Timing of Care and Rate of Reinjury After Anterior Cruciate Ligament Reconstruction. *Orthopaedic Journal of Sports Medicine*. 2024;12(6):23259671241240751. doi:10.1177/23259671241240751
16. Rahman TM, Shaw JH, Mehaidli A, et al. The Impact of Social Determinants of Health on Outcomes and Complications After Total Knee Arthroplasty: An Analysis of Neighborhood Deprivation Indices. *Journal of Bone and Joint Surgery*. 2024;106(4):288-303. doi:10.2106/JBJS.23.00044
17. Khlopas A, Grits D, Sax OC, et al. Neighborhood Socioeconomic Disadvantages Associated With Prolonged Lengths of Stay, Nonhome Discharges, and 90-Day Readmissions After Total Knee Arthroplasty. *The Journal of Arthroplasty*. 2022;37(6):S37-S43.e1. doi:10.1016/j.arth.2022.01.032
18. O'Hara NN, Isaac M, Slobogean GP, Klazinga NS. The socioeconomic impact of orthopaedic trauma: A systematic review and meta-analysis. Farouk O, ed. *PLoS ONE*. 2020;15(1):e0227907. doi:10.1371/journal.pone.0227907
19. Dean RS, DePhillipo NN, Kahat DH, Graden NR, Larson CM, LaPrade RF. Low-Energy Multiligament Knee Injuries Are Associated with Higher Postoperative Activity Scores Compared with High-Energy Multiligament Knee Injuries: A Systematic Review and Meta-analysis of the Literature. *Am J Sports Med*. 2021;49(8):2248-2254. doi:10.1177/0363546520962088
20. Kiwinda LV, Kocher SD, Bethell MA, Taylor ED, DeBaun MR, Péan CA. Relationship Between Social Determinants of Health and Patient Outcomes After Orthopedic Trauma. *Orthopedic Clinics of North America*. 2025;56(3):197-203. doi:10.1016/j.ocl.2025.02.003
21. Khlopas A, Grits D, Sax OC, et al. Neighborhood Socioeconomic Disadvantages Associated With Prolonged Lengths of Stay, Nonhome Discharges, and 90-Day Readmissions After Total Knee Arthroplasty. *The Journal of Arthroplasty*. 2022;37(6):S37-S43.e1. doi:10.1016/j.arth.2022.01.032