Public Insurance Is Associated With Decreased Rates of Surgical Management for Glenohumeral Instability

An Analysis of the Rhode Island All-Payers Claims Database

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Background: Socioeconomic status has been shown to influence patients' ability to access health care.

Purpose: To evaluate the socioeconomic status and/or insurance provider of patients and to determine whether these differences influence the management of shoulder instability.

Study Design: Descriptive epidemiology study.

Methods: The Rhode Island All-Payers Claims Database (APCD) was used to identify all patients between the ages of 5 and 64 years who made an insurance claim related to a shoulder instability event between January 1, 2011, and December 31, 2019. Chi-square analysis and multivariate logistic regression were utilized to determine whether insurance status, social deprivation index (SDI), or median income by zip code were significant predictors of treatment methodology and recurrent instability. Kaplan-Meier failure analysis and Cox regression were used to assess for variation in the cumulative rates of surgical intervention and recurrent instability over 20-year age groups (5-24, 25-44, and 45-64 years).

Results: There were 3310 patients from the APCD query included in the analysis. Bivariate analysis demonstrated significant variation in the rates of surgical stabilization between patients with public and commercial insurance providers ($P < .001$). Patients with public insurance received surgery 1.8% of the time compared with 5.8% of the time in patients with commercial insurance. After controlling for recurrent instability, age, instability type (subluxation or dislocation) and directionality, and sex, patients with public insurance were 79% less likely to receive surgery within 30 days ($P = .035$) and 64% less likely to receive surgery within 1 year ($P = .002$). This disparity was most notable in the 5- to 24-year (hazard ratio [HR] = 0.28; 95% CI, 0.13-0.61) and 25- to 44-year (HR = 0.26; 95% CI, 0.08-0.89) age groups. Neither SDI quartile nor income quartile based on patient primary zip code had a clinically significant influence on rates of surgery or recurrent instability.

Conclusion: These data demonstrate that patients with public insurance have a decreased likelihood of undergoing surgical stabilization to address glenohumeral instability compared with patients with commercial insurance.

Keywords: glenohumeral instability; insurance status; shoulder; social determinants of health

Among young, athletic, and military populations, shoulder dislocation has reported incidence rates as high as 169 and 579 dislocations per 100,000 person-years.[19,20] Attributable to the broad functional range of motion and minimal bony constraint, glenohumeral instability is also common among the general population in the United States, with reported incidence rates of dislocation falling between 12 and 56 injuries per 100,000 person-years.[24,34] There is ample literature describing incidence of shoulder instability differing based on age, biological sex, patient population, and mechanism of action.[10,15,24,34] However, factors influencing recurrence and treatment are less known. Robinson et al[22] showed that the recurrence rate following a primary anterior shoulder dislocation is near 70% within 5 years. Bottoni et al[7] demonstrated the rate of recurrence is dramatically higher in those treated nonoperatively. Determining how different socioeconomic factors (ie, insurance coverage and access to care) influence the management of injuries such as shoulder dislocation and subluxation can help eliminate socioeconomic disparities in health care.[4,14]

As part of the Rhode Island Department of Health's effort to identify health care quality and health outcome improvement opportunities, the Rhode Island All-Payers Claims Database (APCD) is generated from health insurance

The Orthopaedic Journal of Sports Medicine, 11(2), 23259671221147050
DOI: 10.1177/23259671221147050

payments made throughout the state, capturing health data for approximately 1.06 million patients.[2,12] The purpose of this study was to determine whether differences in socioeconomic status and/or insurance provider influence the management and surgical treatment of patients' shoulder instability. We hypothesized that patients with lower-tier insurance and lower socioeconomic status will be less likely to receive surgical intervention and more likely to experience recurrent instability.

METHODS

Data Source

After receiving institutional review board approval for the study protocol and approval from the Rhode Island Department of Health, we utilized the Rhode Island APCD, which is maintained internally at the state level and is composed of health care insurance payment information for all people with health insurance living in Rhode Island. For each patient, it includes demographics (minus patient race or ethnicity), medical services provided for each insurance claim, associated International Classification of Disease, 9th and 10th Revisions (ICD-9 and ICD-10, respectively) and Current Procedural Terminology codes, as well as the date each claim was made. This database does not include data from patients without health insurance and claims made by insurance providers with <3000 members. In total, this database includes data on a significant majority of Rhode Islanders who make a medical claim in the state.

Patient Selection

All patients in the APCD with an ICD-9 code of 718.31, 718.32, or 831.00 through 831.19 or an ICD-10 code of S43.001 through S43.086 or M24.41 through M25.319 were selected. These diagnosis codes represent all codes for shoulder dislocation or subluxation and recurrent instability. Patients who presented between January 1, 2011, and December 31, 2019, were included. Patients whose first claim was for a recurrent instability event or surgery were excluded from the study to capture primary instability events. All patients under the age of 5 years or over the age of 64 years were excluded from the study. All claims made with Medicare Fee-For-Service were excluded from the study, as per the directive of the State of Rhode Island.

Statistical Analysis

The primary outcomes of this study were the rates of surgical stabilization and recurrent shoulder instability. Patient insurance status, income quartile based on zip code, and social deprivation index (SDI) quartile based on zip code were evaluated.[8,27] Bivariate chi-square analysis was used to assess for variation in the rates of surgery and recurrent instability between patients with public (Medicaid, Medicaid replacement, or Medicare) or commercial insurance and between income quartiles and SDI quartiles based on zip code. The SDI is an index of social isolation and is reported on a scale from 1 to 100, with a larger number representing greater social deprivation (ie, lower socioeconomic status).[8] Quartiles were defined as 1-25 (first), 26-50 (second), 51-75 (third), and 76-100 (fourth).

A second model created using multivariate logistic regression was used to further assess the association of insurance type, income quartile, and SDI quartile on surgery and recurrence rates while controlling for age, sex, instability type (subluxation or dislocation), or instability directionality (anterior, posterior, inferior, or unspecified). Recurrent instability event was also included in the model for surgical stabilization. Kaplan-Meier failure analysis and Cox regression were used to assess the cumulative rates of surgical stabilization and recurrent instability among 3 separate 20-year age groups (5-24, 25-44, and 45-64 years) over a 2-year follow-up period from the initial presentation. These age groups were selected to ensure a sufficient sample size for each cohort. P values $<.05$ were considered statistically significant. Analysis was performed using Stata (Version 15.1, StataCorp).

RESULTS

The query of the APCD returned 3310 patients who made an insurance claim for a primary shoulder instability event in Rhode Island between January 1, 2011, and December 31, 2019. The mean age of the population was 35.3 ± 16.4 years, with female sex being predominant (2272 cases; 68.6%). Among the full population, 4.6% (151/3310) of patients received surgical stabilization and 17.3% (571/3310) filed an insurance claim for recurrent instability. Patient socioeconomic demographics can be seen in Table 1.

Bivariate chi-square analysis revealed a significant difference in surgery rates between insurance groups (Table 2). The rate of surgery in those with commercial insurance was 5.8%, which was significantly greater than in those

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Final revision submitted September 21, 2022; accepted October 21, 2022.
One or more of the authors has declared the following potential conflict of interest or source of funding: B.D.O. has received research support from Arthrex, Mitek, and MTF; consulting fees from ConMed, DePuy/Medical Device Business Systems, Miach, MTF, and Vericel; royalties from ConMed; and honoraria from Vericel; and is a member of the scientific advisory board for Vivorte and a paid associate editor for the *American Journal of Sports Medicine*. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.
Ethical approval for this study was obtained from Lifespan (ref. No. 217919).

TABLE 1
Socioeconomic Demographics of Patients who Experienced Shoulder Instability in Rhode Island Between January 1, 2011, and December 31, 2019 (N = 3310 Patients)[a]

	No. of Patients	Percentage (95% CI)
Insurance type		
Public	1008	30.5 (28.9-32.0)
Commercial	2302	69.5 (68.0-71.1)
Income quartile		
1st (<$64,579.50)	986	33.3 (31.6-35.0)
2nd ($64,579.51-$78,660.00)	912	30.8 (29.2-32.5)
3rd ($78,660.01-$91,237.50)	520	17.6 (16.2-19.0)
4th ($91,237.51-$194,450.00)	544	18.4 (17.0-19.8)
SDI quartile		
1st (1-25)	947	28.6 (27.1-30.2)
2nd (26-50)	912	27.6 (26.1-29.1)
3rd (51-75)	356	10.8 (9.7-11.9)
4th (76-100)	1095	33.1 (31.5-34.7)

[a]SDI, social deprivation index.

TABLE 2
Binary Chi-Square Analysis of Surgical Stabilization and Recurrent Instability Rates[a]

Variable	Surgical Stabilization, %	*P*	Recurrent Instability, %	*P*
Insurance type		**<.001**		.112
Public	1.8		15.7	
Commercial	5.8		17.9	
Income quartile		**.026**		.932
1st	4.3		18.0	
2nd	3.5		17.3	
3rd	6.9		18.5	
4th	4.4		17.3	
SDI quartile		.172		.127
1st	4.9		17.6	
2nd	5.5		19.4	
3rd	2.8		15.7	
4th	4.1		15.6	

[a]Boldface *P* values indicate statistically significant difference between variables ($P < .05$). SDI, social deprivation index.

with public insurance (1.8%) ($P < .001$). Surgery rates also varied by income quartile ($P = .026$). Surgery rates did not differ based on patients' SDI associated with their zip code. There was no difference in the rates of recurrent instability between insurance groups, income quartiles, or SDI quartiles.

The multivariate logistic regression model demonstrated that insurance status significantly contributed to the likelihood of surgical stabilization at both 30 days and 1 year after initial presentation (Table 3). Patients with public insurance were 79% less likely to receive surgery within 30 days (odds ratio [OR] = 0.21; 95% CI, 0.05-0.90) and 64% less likely to receive surgery at 1 year (OR = 0.36; 95% CI, 0.19-0.69) compared with those with commercial insurance. There was no significant association between income quartile and SDI quartile and surgery rates at 30 days after initial presentation. At 1 year postinjury, only patients in the third income quartile had significantly increased rates of surgery compared with those patients in the fourth income quartile (OR = 2.89; 95% CI, 1.29-6.47).

Figure 1 depicts the Kaplan-Meier failure analysis for the cumulative rate of surgical stabilization over a 2-year follow-up period after a primary instability event for each of the 20-year age groups. Cox regression analysis demonstrated that patients with commercial insurance were more likely to undergo surgery for their shoulder instability than patients with public insurance in the 5- to 24-year (Figure 1A) and 25- to 44-year (Figure 1B) age groups. The cumulative rate of surgical stabilization in the commercial and public insurance cohorts among the 5- to 24-year age group was 2.2% and 7.7% (hazard ratio [HR] = 0.28; 95% CI, 0.13-0.61), respectively. For the 24- to 44-year age group, the surgery rate in patients with commercial and public insurance was 0.9% and 3.3% (HR = 0.26; 95% CI, 0.08-0.89), respectively. There was no difference in the rate of surgery between those with commercial or public insurance in the 45- to 64-year age group ($P = .380$).

The same analysis was done for the rates of recurrent instability (Figure 2). Within 2 years of a primary instability event, the cumulative rate of recurrent instability in patients with commercial insurance in the 5- to 24-year age group was 21.0%, compared with 15.2% in their public insurance counterparts (HR = 0.69; 95% CI, 0.50-0.94). There was no difference in the cumulative rate of recurrent instability between those with commercial and public insurance in the 25- to 44-year age group ($P = .588$). In the 45- to 64-year age group, 4.5% of patients with commercial insurance experienced recurrent instability, compared with 7.7% of patients with public insurance (HR = 1.74; 95% CI, 1.04-2.91).

DISCUSSION

In the present study, we demonstrated that public insurance is associated with decreased rates of surgical stabilization to address glenohumeral instability. Patients between the ages of 5 and 64 years with public (Medicaid, Medicaid Replacement, or Medicare) insurance have a 79% and 64% decreased likelihood of receiving surgery 30 days and 1 year, respectively, following a shoulder instability event compared with patients with commercial insurance. This bias around insurance status has been reported previously among the orthopaedic community, with >50% of orthopaedic surgeons considering insurance status as the primary driver of access disparities for orthopaedic care.[1] Less than 50% of orthopaedic practices in the United States accept Medicaid insurance, demonstrating the deeply rooted implicit bias toward public insurance in the orthopaedic community.[18] The relationship between Medicaid coverage and decreased access to health care has been reported previously for patients with shoulder pathology, along with evidence that patients with Medicaid are half as

TABLE 3
Multivariate Logistic Regression of Likelihood of Undergoing Surgical Intervention Within 30 Days and 1 Year or Presentation During the Study Period[a]

	Surgical Stabilization Within 30 Days		Surgical Stabilization Within 1 Year	
Variable	OR (95% CI)	*P*	OR (95% CI)	*P*
Insurance type				
Public	0.21 (0.05-0.90)	**.035**	0.36 (0.19-0.69)	**.002**
Commercial	Reference		Reference	
Income quartile				
1st	0.82 (0.26-2.64)	.746	1.78 (0.81-392)	.152
2nd	0.95 (0.30-3.05)	.936	1.68 (0.75-3.77)	.205
3rd	0.43 (0.08-2.22)	.311	2.89 (1.29-6.47)	**.010**
4th	Reference		Reference	
SDI quartile				
1st	Reference		Reference	
2nd	0.81 (0.28-2.36)	.698	1.59 (0.90-2.83)	.111
3rd	1.14 (0.30-4.39)	.844	1.06 (0.44-2.57)	.894
4th	1.23 (0.48-3.17)	.666	1.49 (0.84-2.65)	.172

[a]Multivariate logistic regression completed while controlling for recurrent instability, age, sex, instability type, and instability directionality. Boldface *P* values indicate statistically significant difference compared with reference variable ($P < .05$). OR, odds ratio; SDI, social deprivation index.

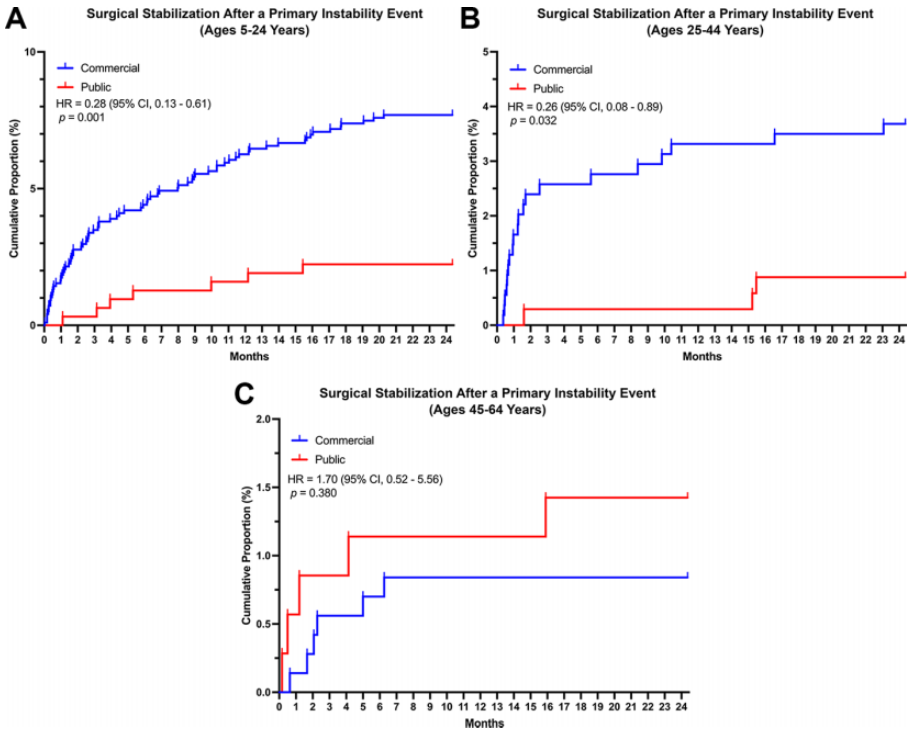

Figure 1. Kaplan-Meier failure analysis with log-rank analysis overlaid depicting the cumulative percentage of surgical stabilization within 2 years of a primary instability event among patients with commercial and public insurance, according to age group: (A) 5 to 24 years, (B) 25 to 44 years, and (C) 45 to 64 years. HR, hazard ratio.

likely to arrive at their appointments.[6,9,13,16,21,23,32] Bokshan et al[6] reported that patients with commercial insurance were 93% more likely than those with Medicare to undergo surgery after presenting to the emergency department for shoulder instability. This information speaks to the impact of lower socioeconomic status on access to health care. One of the contributing factors is the significant transportation barriers to receiving health care for these patients. In a 20-year study, Wolfe et al[33] reported that, among those patients living below the federal poverty line, 7% reported delayed medical care because of a transportation barrier. Similarly, 5.6% of those with Medicaid

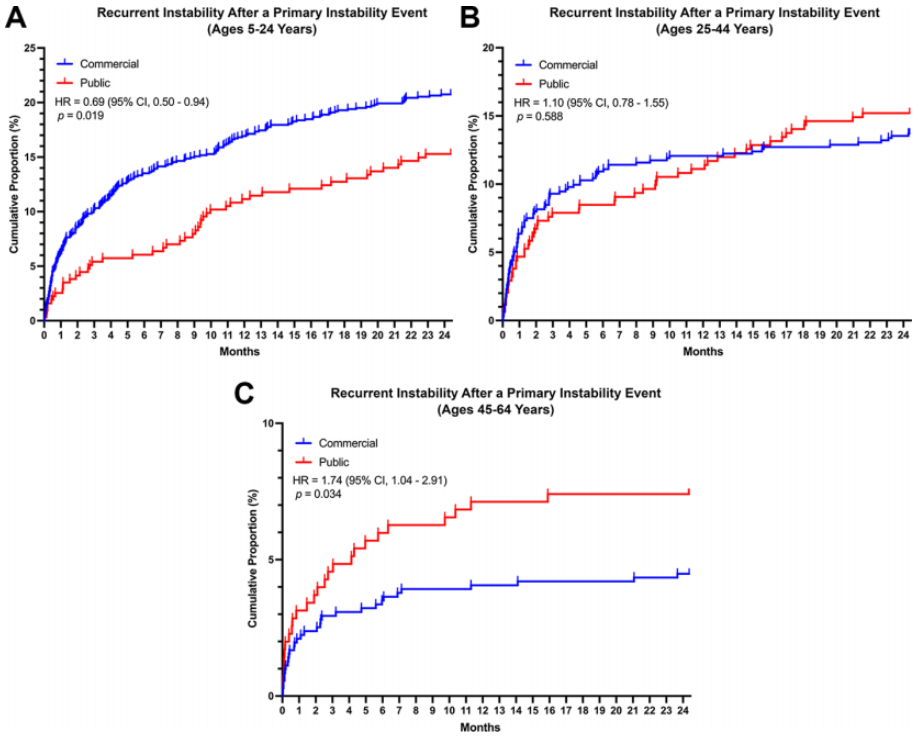

Figure 2. Kaplan-Meier failure analysis with log-rank analysis overlaid depicting the cumulative percentage of recurrent shoulder instability within 2 years of a primary instability event among patients with commercial and public insurance, according to age group: (A) 5 to 24 years, (B) 25 to 44 years, and (C) 45 to 64 years. HR, hazard ratio.

insurance reported delaying care due to transportation barriers, which is a 295% increase from the national average.

In a previous study analyzing shoulder instability epidemiology using the Rhode Island APCD, Albright et al[2] demonstrated that age significantly affects the odds of both undergoing surgery and experiencing recurrent instability. To better account for the impact of age on the odds of surgery and recurrent instability, the sample was divided into three 20-year age groups for subsequent Kaplan-Meier failure and Cox regression analyses. Within a 2-year follow-up period in the 5- to 24-year-old and 25- to 44-year-old age groups, the cumulative rate of undergoing surgery to address glenohumeral instability was significantly greater among those with commercial insurance compared with those with public insurance. However, recurrent instability has been shown to significantly increase the likelihood of undergoing surgical stabilization to prevent further recurrence.[6,17] This study shows that patients aged 5 to 24 years with commercial insurance were significantly more likely to experience recurrent instability compared with their age-matched counterparts with public insurance within a 2-year follow-up. This likely affects the rate of surgical intervention seen in this same group, partially explaining the significantly larger cumulative rate of surgical intervention compared with patients with public insurance.

Previous studies have demonstrated that participants of organized athletics or other physically demanding activities are more likely to experience primary and recurrent glenohumeral instability.[19,22,26,31] However, organized athletics is expensive. Project Play from the Aspen Institute reported in 2019 that while free recreational sports are still available, that is less often the case in organized team sports like ice hockey, baseball, softball, soccer, lacrosse, and basketball.[5] The average annual costs for the aforementioned sports often exceeds $1000, sometimes reaching even $10,000 to $12,000. The Aspen Institute also reported that children of low-income families (<$25,000 annually) were nearly half as likely to participate in sports on a regular basis compared with children of higher-income families (≥$100,000).[5] This has likely contributed to the 45% decrease in organized sports participation seen over the past decade.[11,29] If cost is such a driver of organized sports participation, speculatively, this may partially explain why patients in this age cohort with commercial insurance are more likely to experience recurrent instability. The families of this population may be more able to afford the cost of organized athletics compared with those patients with public insurance. If this were true, it would explain why the same difference in cumulative recurrence rates seen in the younger cohort is not present in the 25- to 44-year-old age group. The older cohort is less likely to participate in the types of organized athletics that predispose someone to primary and recurrent shoulder instability. Another speculative explanation is patients with public insurance may not seek care for their recurrent instability, which would manifest as decreased rates of reported recurrent instability in this cohort.

Finally, the increased recurrence rate seen in the commercial insurance group of the youngest cohort likely fails to completely account for the much greater increase in the likelihood of undergoing surgery than in the public insurance group. The HR of experiencing recurrent instability in patients with public insurance was 0.69, while the HR of undergoing surgery was significantly less at 0.28. This >140% difference in the 2 HRs means there is likely another factor besides increased rates of recurrent instability contributing to the increased cumulative rate of undergoing surgery in patients with commercial insurance compared with those with public insurance. Akin to the multivariate logistic regression model, the Kaplan-Meier failure analysis demonstrated that patients with public insurance were significantly less likely to undergo surgical stabilization compared with those with commercial insurance.

Among the middle age group, patients with commercial insurance underwent surgery at significantly increased rates, even when there was no difference in the rates of recurrent instability. Among the oldest age group, there was no difference in the rate of undergoing surgery, even when the public insurance group experienced a significantly increased cumulative rate of recurrent instability. This information is consistent with the original hypothesis that patients with commercial insurance are more likely to undergo surgical stabilization to address glenohumeral instability compared with similarly aged patients with public insurance. One potential explanation is that older patients with recurrent instability may opt for nonoperative management to avoid the lengthy rehabilitation and work restrictions that come with glenohumeral stabilization surgery.[3] Speculatively, patients with public insurance in these 2 older age brackets are likely subjected to other socioeconomic pressures that may discourage them from pursuing surgical stabilization for both index and recurrent shoulder instability. For example, they may not have the financial flexibility to take time off from work to undergo surgical stabilization for their instability event. This would explain the findings in both the 25- to 44-year and 45- to 64-year age brackets. Among the 25- to 44-year age group, patients with public insurance were equally likely to experience recurrent instability as those with commercial insurance but were 74% less likely to undergo surgical stabilization. Similarly, among the 45- to 64-year age group, patients with public insurance were 74% more likely to experience recurrent instability but underwent surgical stabilization at rates statistically similar to those with commercial insurance. However, there are insufficient data and evidence to further comment on this speculative explanation as the Rhode Island APCD does not include data on individual income levels and other socioeconomic factors, such as race and education level, that could further affect decisions to pursue surgical stabilization.

This study demonstrated that neither SDI quartile nor income quartile based on a patient's primary zip code contributed significantly to the rates of surgery or recurrent instability. While the chi-square analysis for surgical rates did demonstrate a statistically significant difference between income quartiles, this difference likely holds no clinical significance. Similarly, the multivariate logistic regression analysis demonstrated that patients in the third income quartile were more likely to receive surgery within a year compared with the fourth income quartile, but there was no difference between the first and second income quartiles. While the SDI—a composite measure used to quantify social deprivation as it relates to health care outcomes—has been used to predict health care access and need in the primary care setting, it did not prove to be a statistically significant predictor of surgical stabilization or recurrent shoulder instability.[8]

Finally, the rate of recurrent instability seen in this study was 17.3% in patients who experienced a primary instability event. This value is low compared with previously reported recurrent shoulder instability rates. Wasserstein et al[30] described the pooled overall rate of recurrent instability following primary anterior shoulder dislocations to be 21% (range, 18%-88%). The lower rate seen in the present study is likely multifactorial. First, this may be partially the result of those patients with public insurance electing to not seek medical care for recurrent instability. Another speculative explanation is that the initial populations generated in this study include both shoulder dislocations and shoulder subluxations. The study by Wasserstein et al analyzed the rates of recurrence only following traumatic anterior shoulder dislocations, which may contribute to their reported pooled recurrence rate's being higher than that of the current study.[28,30]

Limitations

There are limitations to this study. First and foremost, there are several other factors that contribute to the decision to pursue surgical or conservative management of a shoulder instability event, such as the degree of glenohumeral bone loss, hyperlaxity, number of instability events, etiology, activity level, and more. Unfortunately, these variables are not available in the statewide insurance data set and hence were not included in the analyses of surgical stabilization and recurrent instability. Similarly, while zip codes, and therefore respective median incomes and SDI, were available in the data set and included in the multivariate analyses, other socioeconomic factors, like individual income, race, and education, were not. These factors have been shown to influence patient care and subsequently could have confounded the results of this study. Second, inherent to any database study, there is the possibility of missed shoulder instability events due to improper coding and there is no way to assess the severity of the glenohumeral instability, as this would affect the decision to manage a patient either operatively or nonoperatively. To minimize the potential for including miscoded diagnoses, all patients over the age of 64 years were excluded from this study, as these patients are at an increased risk of fracture-dislocations, which may be coded as pure dislocations.[25] Third, as Rhode Island is a small state geographically, there is the chance that patients received treatment outside of the state, and those medical claims would have not been included in the Rhode Island APCD. To address this limitation, those patients whose first insurance claim for a

shoulder instability event during the study period was coded as a recurrent instability event or was tied to a surgical procedure were excluded from the study. These patients may have begun their treatment outside of the state of Rhode Island and their medical records in the APCD would have been incomplete. Similarly, as this study is strictly applicable to Rhode Island, it is subject to sampling bias and may not be generalizable across the United States. Last, all patients using Medicare Fee-For-Service were excluded from the analysis as per the state's directive. As patients over the age of 64 years were excluded from the study, this limitation likely had minimal impact on this study. Despite these limitations, this study was able to capture >3000 patients with a primary instability event over a 9-year period and follow their care to analyze the impact of insurance and socioeconomic status on rates of both surgical management to address glenohumeral instability and recurrent instability.

CONCLUSION

Following a primary instability event, we found insurance status (public or commercial) to contribute significantly to the management of shoulder instability in a cohort of >3000 patients over a 9-year period. Patients with public insurance were less likely to undergo surgery to address glenohumeral instability. This demonstrates socioeconomic disparities and barriers to care for patients with shoulder instability. This study helps to identify potential sources of implicit bias in health care providers rendering care for shoulder instability, as well as uncovering inequitable treatment.

ACKNOWLEDGMENT

The authors thank Paul Stey for his assistance with navigating the Rhode Island APCD.

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