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Original Research

The Effect of Social Deprivation on Hospital Utilization Following Distal Radius Fracture Treatment

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Purpose: Social determinants of health disparities have been shown to adversely impact outcomes following distal radius fracture (DRF) treatment. Identifying risk factors for increased hospital use following DRF has been historically difficult; however, it is of utmost concern to orthopedic surgeons to improve outcomes and decrease the total cost of care. The effect of social deprivation following DRF has yet to be fully investigated.
Methods: This is a retrospective cohort analysis of a single institution's experience in treating DRF with either an operative or nonsurgical modality between 2005 and 2020. Patient demographic information and health care utilization (hospital readmission, emergency department [ED] visitation, office visits, and telephone use) were collected from within 90 days of treatment. Area Deprivation Index (ADI) national percentiles were recorded. Patients were stratified into terciles based on their relative level of deprivation, and their outcomes were compared. Secondary analyses included stratifying patients based on treatment modality, race, and legal sex.
Results: In total, 2,149 patients were included. The least, intermediate, and most deprived groups consisted of 552, 1,067, and 530 patients, respectively. Risk factors for hospital readmission included higher levels of relative deprivation. Identifying as Black or African American and nonsurgical management were risk factors for increased ED visitation. No differences in rate of hospital readmission, ED visitation, office visitation, or telephone use were seen based on deprivation level.
Conclusions: High levels of social deprivation, treatment modality, race, and legal sex disparities may influence the amount of hospital resource utilization following DRF treatment. Understanding and identifying risk factors for greater resource utilization can help to mitigate inappropriate use and decrease health care costs. We hope to use these findings to guide clinical decision making, educate patient populations, and optimize outcomes following DRF treatment.
Type of Study/Level of Evidence: Therapeutic III.

Social determinants of health (SDoH) are defined as nonmedical factors that influence an individual's health outcomes. This concept applies to all fields of medicine, and orthopedic surgery is no exception. SDoH have been shown to effect outcomes in several orthopedic subspecialties, including joint arthroplasty, upper extremity surgery, spine, trauma, and sports medicine.[1–13] Therefore, it is crucial for orthopedic surgeons to understand the connection that SDoH may have in predisposing patients to inferior outcomes following surgeries.

The Area Deprivation Index (ADI) is a comprehensive measure of SDoH.[14] Created over three decades ago, the ADI ranks neighborhoods, or census block groups, by socioeconomic disadvantage.[14] Factors incorporated in the measure include theoretical domains of housing quality, education, employment, and income all centered on an individual's residential address. Therefore, the ADI can be used, especially for the most disadvantaged neighborhood groups, to correlate the level of health outcomes based on the patient's census block group. This concept can be applied to patients

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Table 1
Patient Demographics and Outcomes

Tercile	Least Deprived	Intermediate Deprived	Most Deprived
Number	552	1,067	530
Age (years)	52.5 ± 21.1	51.3 ± 22.2	50.1 ± 19.0
Legal sex (% female)	71.6[*]	72.1[†]	65.1[*,†]
Race (%)			
White	94.2[*,‡]	92.4[†,‡]	55.8[*,†]
Black	0.9[*,‡]	3.5[†,‡]	34.7[*,†]
Other	4.9[*]	4.1[†]	9.4[*,†]
Treatment Modality (% nonsurgical)	58.0	56.0	56.2
Rate of 90-Day Readmission (%)	2.2	2.2	3.3
Rate of ED Visitation in (%)	6.9	7.4	8.3
Number of Follow-up Visits in 90 Days	1.6 ± 1.8	1.7 ± 1.9	1.7 ± 2.0
Number of Telephone Calls in 90 Days	0.7 ± 1.3	0.8 ± 1.4	0.8 ± 1.4

[*], [†], and [‡] used to denote differences between groups at $P < .05$.

who have undergone distal radius fracture (DRF) repairs, one of the most common upper extremity fractures.[15]

Previous research examining the influence of social factors on postoperative outcomes following DRF treatment has been somewhat limited. Although two studies were unable to establish any significant links between social deprivation and DRF outcomes, another study reported that patients with lower income levels experienced poorer patient-reported outcomes following DRF repair.[1,2,16] Moreover, there is evidence suggesting that lower socioeconomic status and Medicaid payer status are associated with higher rates of hospital readmission following DRF repair.[17,18] Considering the frequency of DRFs and the relative paucity of research in this domain, it is imperative that further investigations be undertaken.

The aim of this study is to evaluate the effect of social deprivation using the ADI on postoperative hospital utilization within 90 days of distal radius fracture treatment with either an operative or nonsurgical modality. We hypothesize that patients with higher levels of social deprivation will be at increased risk of using hospital resources compared to less deprived patients.

Materials and Methods

This is a retrospective cohort analysis of all patients with distal radius fractures at a single institution from 2005 to 2020. This study was approved by our institutional review board and was determined not to meet criteria for human subject research under 45 CFR 46.102 as no information was individually identifiable, there was no intervention or interaction with living individuals, and there was no involvement of biological specimens or human information/data that was used to support marketing of a US Food and Drug Administration-related drug, biologic, or device product. Patients were queried using TriNetX software and stratified according to their treatment modality as operative (Current Procedural Terminology codes 26507, 26508, and 26509) or nonsurgical (Current Procedural Terminology codes 26500 and 26505) patients. Patients were excluded from the study if they were polytrauma patients or undergoing repeat surgery for their fracture. Demographic data (age, legal sex, race) and data pertaining to hospital utilization (all-cause readmissions, emergency department [ED] visits, office visits, telephone calls) were collected. Specific outcome variables included hospital readmissions, ED visits, follow-up office visits, and telephone calls made within 90 days of surgery or treatment.

The ADI was used as a measure of social deprivation. The ADI incorporates 17 US census-based factors, including income, housing, insurance type, and education to determine social deprivation within each census block. A score from 0 to 100 is generated and assigned to each patient, with a higher score indicating more social deprivation. Patients were grouped into terciles according to their relative level of deprivation with groups one, two, and three representing the least, intermediate, and most deprived patients, respectively.

Statistical analysis was performed using IBM SPSS statistical software. Continuous variables are expressed as means and standard deviations. Categorical variables are expressed as percentages. Analysis for continuous variables was performed using analysis of variance or Students *t* test, where appropriate. Categorical variables were analyzed using Chi-square tests. Additionally, to account for demographic differences between groups, secondary analysis using Poisson regressions were employed to estimate incidence rate ratios (IRRs) and 95% confidence intervals (CIs) for count data. A *P* value of less than 0.05 was used to determine significance.

Results

A total of 2,149 patients met the inclusion and exclusion criteria for this study. Demographic data are displayed in Table 1. There was no difference in age between groups ($P = .173$). The most deprived group had a higher proportion of patients identifying as male ($P < .05$) and Black or African American ($P < .05$) compared to the least and intermediate deprived groups. Overall, 56.5% of patients were treated nonsurgically for their DRF, with no difference seen between groups ($P = .729$).

There was no difference in the rate of hospital readmission within 90 days of surgery between groups ($P = .293$) (Table 1). There was a 2.15 times greater chance of hospital readmission for patients in the most deprived tercile (IRR = 2.15, 95% CI 1.05–4.39) when controlled for age, legal sex, race, and treatment modality (Table 2). No other predictors for hospital readmission were identified.

There was no difference in the rate of ED visitation within 90 days of surgery between groups ($P = .530$) (Table 1). Level of deprivation was not a predictor of increased ED visitation within 90 days of surgery. Independent predictors for ED visitation included identifying as Black or African American (IRR = 2.85, 95% CI 1.90–4.29), identifying as Other (IRR = 1.85, 95% CI 1.10–3.12), and nonsurgical management (IRR = 2.02, 95% CI 1.50–2.72) (Table 2).

There was no difference in the average number of office visits within 90 days of treatment among the least, intermediate, and most deprived groups ($P = .677$) (Table 1). Patients treated nonsurgically had a 2.56 times greater chance of increased office use compared to patients treated with surgery (IRR = 2.56, 95% CI 2.37–2.77) (Table 2).

There was no difference in the average number of telephone calls made within 90 days of surgery between groups ($P = .844$)

Table 2
Summary of Statistically Significant Findings

	Treatment Modality	90-Day Readmission	90-Day ED Visitation	Follow-Up Visits	Telephone Calls
Differences in Averages	No difference between groups ($P = .729$)	No difference between groups ($P = .293$)	No difference between groups ($P = .530$)	No difference between groups ($P = .677$)	No difference between groups ($P = .844$)
Risk Factors	Treatment with Surgery No risk factors identified	Most Deprived (adjusted IRR 2.15, 95% CI 1.05–4.39)	Identifying as Black (adjusted IRR 2.85, 95% CI 1.90–4.29) Identifying as Other (adjusted IRR 1.85, 95% CI 1.10–3.12) Nonsurgical management (adjusted IRR 2.02, 95% CI 1.50–2.72)	Nonsurgical management (adjusted IRR 2.56, 95% CI 2.37–2.77)	Surgical Management (adjusted IRR 1.34, 95% CI 1.22–1.48)

(Table 1). Surgical management was the only independent risk factor for increased telephone use within 90 days of treatment (IRR = 1.34, 95% CI 1.22–1.48) (Table 2).

Discussion

Distal radius fractures are one of the most common fractures among individuals in the United States.[19] The incidence and associated health care expenditures of DRF repairs is expected to increase over time as the aging population in the United States also increases.[18] The incidence of DRF has also been shown to be higher in socially deprived individuals, which contributes to morbidity and decreases quality of life for those with socioeconomic challenges.[20] Our study found that individuals in the most socially deprived group were at increased risk of 90-day readmission to the hospital following DRF. Racial disparities and treatment modality, specifically identifying as Black or African American and nonsurgical management, were also identified as risk factors for ED visitation following DRF.

Factors related to social deprivation have reliably been associated with increased use of hospital resources following DRF, with more patients of lower socioeconomic status being admitted to hospitals following DRF.[18] Increased hospital readmission rates following DRF have been correlated with socially funded insurance programs, lower income, higher levels of comorbid conditions, and presence of mental health conditions.[17,18,21–23] Readmission to the hospital following orthopedic surgery imposes substantial costs to both health care providers and patients.[18,22,24,25] Given the recent emphasis on value-based care in orthopedics, increased hospital resource utilization following surgery holds significant implications for provider reimbursement.[26] Consequently, identifying and understanding risk factors for increased hospital utilization following DRF is of utmost concern for orthopedic surgeons.

The literature evaluating the effect of social deprivation or related factors on DRF has not reached a clear consensus, with some studies showing worse outcomes and others showing no differences in outcomes.[1,5,8,16,23,27] Although more research on the effect of social deprivation following DRF needs to be done, social deprivation has been shown to negatively impact outcomes in several different orthopedic surgeries, including tibial shaft fractures, joint arthroplasty, and rotator cuff repair.[4,7,14,28–34] Our findings largely align with established trends in the literature; however, there is a substantial lack of homogeneity in how studies measure social deprivation, using metrics such as income, education level, or insurance type as a proxy for measuring relative disadvantage. The ADI is a validated metric that has been used in several high-quality research studies spanning various medical disciplines to effectively characterize SDoH.[14,28–34] The ADI considers variables like income, education, employment, and housing attributes. Unique to the ADI is its inclusion of a social aspect in its classification system, making it a comprehensive measure of relative disadvantage.

Numerous interventions have been proposed to curtail hospital utilization rates following orthopedic surgery. Pertaining to DRF specifically, inadequate pain control is a large, potentially modifiable reason for readmission or ED visitation.[17,21] In this context, proactive measures, such as multimodal pain management, exhibit promise in helping to reduce readmissions, as they have demonstrated effectiveness in reducing acute postoperative pain following hand surgery.[35] Furthermore, patient education on pain management expectations may be an effective intervention, as it has been shown to reduce postoperative opioid use.[36] It is also important to note that social deprivation has been shown to be a predictor of pain following several orthopedic surgeries, including DRF.[5,37–40] Additionally, racial disparities may contribute to this issue, with Black and Latino patients reporting more severe pain following DRF compared to their White counterparts.[41] Although the fundamental cause for this outcome is likely multifactorial, it is reasonable to suspect that social deprivation factors, such as inadequate access to postoperative rehabilitation services, low income, unemployment, insufficient insurance coverage, and transportation access, may influence this gap in pain control.[1,2,16,20,27,41,42] Importantly, satisfaction with pain management is also a metric in the Hospital Consumer Assessment of Healthcare Providers and Systems survey, which directly effects hospital reimbursement through the Hospital Value-Based Purchasing Program.[43]

Irrespective of relative levels of deprivation, racial disparities have been correlated to worse functional outcomes following several orthopedic procedures.[11,41,44–51] This pattern is also seen in DRF, as evidenced by one study showing that both Black and Latino patients had worse physical function and greater pain compared to White patients following DRF treatment.[41] Another study demonstrated that Black patients had longer lengths of stay and increased risk of readmission following DRF repair.[52] Our study findings align with these health disparity trends. Specifically, our analysis revealed that identifying as Black or African American was an independent risk factor for ED visitation after surgery.

Given our results, it is crucial to explore how health care practitioners can better connect with patients, manage expectations, and deliver care that minimizes the need for additional health care visits, particularly among those facing socioeconomic challenges. Our study highlights the pivotal role that the ADI can play in identifying high-risk patients and facilitating timely and tailored interventions. Through regular screenings for social determinants, personalized treatment plans, patient education, and collaboration with support services, health care providers can address the unique

needs of individuals facing social disadvantages. Additionally, providers can provide education encouraging the use of independent urgent care centers to redirect nonlife-threatening cases, alleviating strain on hospitals and promoting cost-effective solutions.

Study limitations include sourcing our data from a single hospital database reliant on the accurate entry of diagnosis codes for patient inclusion criteria. Moreover, use of external hospital or ED visits may not have been captured as after acute care use in certain patients. In addition, reason for hospital utilization was not included in the analysis and represents a potential confounding variable. The application of the ADI also has limitations in that it uses the American Community Survey 5-year data for its creation (eg, data from 2017 to 2021). Consequently, the measure may not represent the most current neighborhood rankings at a given time across all patients. The ADI also relies on census block groups, which is the nearest approximation to a "neighborhood" and therefore, other geographic units, including zip code, will not be valid. Despite these limitations, generalized trends based on neighborhood ADI may still be assessed.

A patient's level of social deprivation may impact their utilization of hospital services after receiving treatment for a DRF. Our research revealed that patients who were in the highest tercile of social deprivation or identified as Black or African American had a higher likelihood of requiring health care services through readmission to the hospital or visits to the ED. By recognizing which patients are more susceptible to such risks, there is an opportunity to enhance quality of care for these individuals and alleviate the burden on the health care system.

Conflicts of Interests

No benefits in any form have been received or will be received related directly to this article.

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