



The effects of social determinants of health on rotator cuff repair utilization and outcomes: a systematic review



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Background: Since various social determinants of health (SDOH) have the potential to impact the utilization and postoperative outcomes of rotator cuff repair (RCR), a review of the literature is warranted. Therefore, the purpose of this systematic review was to evaluate the effects of SDOH on RCR utilization and postoperative outcomes in order to recognize external factors that may influence patients' access to RCR and optimal clinical outcomes.

Methods: Search terms related to RCR, utilization, outcomes, and SDOH were used to identify studies that reported associations between any SDOH (as defined by the World Health Organization) and RCR utilization, access, cost, or postoperative outcomes. Articles that did not isolate RCR or did not evaluate an SDOH were excluded. Nonrandomized studies were evaluated for study quality using the Methodological Index for Nonrandomized Studies score. Due to the heterogeneity of the reported data, only qualitative analysis was possible.

Results: Overall, 842 articles were considered for inclusion and 14 studies were included in qualitative analysis. The average Methodological Index for Nonrandomized Studies score of included studies was 14.1 ± 5.0 . The SDOH most frequently evaluated were insurance status and race/ethnicity. Non-White race is associated with lower odds of surgery and physical therapy (PT) utilization, as well as delayed treatment. Similarly, public insurance is associated with lower PT and surgery utilization rates and decreased acceptance for postoperative PT. Postoperatively, public insurance is associated with worse patient-reported outcome scores and lower return to work rates.

Conclusion: Various SDOH can influence access, utilization, and outcomes of RCR. Orthopedic surgeons should be aware of how factors of race and insurance type can influence a patient's treatment and recovery after RCR.

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The World Health Organization (WHO) defines Social Determinants of Health (SDOH) as nonmedical factors that influence health outcomes.¹⁰ These include income/social protection, education, unemployment, working conditions, food insecurity, housing, early childhood development, social inclusion, structural conflict, and access to affordable health services.¹⁰ Several studies

have investigated and shown the profound impact these factors have on influencing health equity.^{2,14,23,32,35,38,39} Whitman et al³⁹ specifically report that SDOH can impact 50% of the variation in health outcomes as compared to the 20% variation seen in clinical care.

A similar impact is seen in patient outcomes following surgical interventions as education and income status have been shown to contribute to postoperative outcomes.^{3,11,18,37,42} Paro et al²⁵ found that the risk of postoperative events worsens with increased social vulnerability in postoperative patients, while James et al¹³ report that due to the beneficial aspects of proper nutrition on promoting healing and immunity, food insecurity and lack of access to nutritious food among individuals of lower socioeconomic status (SES) can also act as a SDOH in postoperative recovery.

Institutional review board approval was not required for this systematic review. This work was performed at Rothman Orthopaedic Institute at Thomas Jefferson University.

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Several systematic reviews and meta-analyses have analyzed the effects of SDOH in the orthopedic setting. Kamalpathy et al¹⁶ found that patients with less access to education and more economic disparities had increased rates of major complications and readmission for hip and ankle fractures. Costa et al⁷ report that SDOH affect patient utilization of surgical intervention, with factors such as employment status or health insurance coverage leading to decreased utilization of recommended health care in patients with knee osteoarthritis. SDOH have also been shown to be a predictor of patient care and disparity in the orthopedic setting.²⁰ For example, Ziedas et al⁴³ found that factors such as Black race, Hispanic ethnicity, and lower SES were associated with delays in access to care for anterior cruciate ligament reconstruction patients which contributes to an increased potential for subsequent meniscal and articular cartilage injury, which would affect clinical outcomes.

Since various SDOH have the potential to impact the utilization and postoperative outcomes of rotator cuff repair (RCR), a review of the literature is warranted. Therefore, the purpose of this review was to evaluate the effects of SDOH on RCR utilization and postoperative outcomes in order to help orthopedic surgeons and health-care administrators recognize external factors that may influence patients' access to care and clinical outcomes.

Materials and methods

This systematic review was performed according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.²⁴ All studies published from inception until October 2022 were identified in the PubMed, Medline (OVID), and Sport-Discus databases. Search terms used were related to RCR, utilization or outcomes, and SDOH.

Article screening was completed by two independent investigators (A.N. and A.O.). Duplicate studies were removed, and the remaining articles were screened by title and abstract. Peer-reviewed publications were included that were published in English, were level 4 evidence or greater, and reported associations between any SDOH (as defined by the WHO) and RCR postoperative outcomes, cost, and/or utilization. Articles that did not isolate RCR or did not evaluate an SDOH were excluded. Following initial screening, the references of the articles were checked for potential missed articles.

Included studies had the following categories of data collected: study design, patient demographics, study quality, postoperative complications, revisions, functional outcomes, costs, and utilization rates.

Nonrandomized studies were evaluated for study quality using the Methodological Index for Nonrandomized Studies (MINORS) score.³³ Categories were scored as 0 (not reported), 1 (reported but inadequate), or 2 (reported and adequate). Noncomparative studies featured 8 questions for the MINORS score with total scores ranging from 0 (poor study quality) to 16 (high study quality), while comparative studies instead featured 12 questions with total scores ranging from 0–24.

Statistical analysis

Due to the heterogeneity of the reported data, only qualitative analysis was possible. Data regarding study demographics, RCR utilization, and RCR postoperative outcomes were reported separately.

Results

Overall, 842 articles were considered for inclusion and 14 studies were included in qualitative analysis (Fig. 1). Seven included studies evaluated the effects of SDOH on access, utilization, or cost

of RCR (Table I).^{4,6,8,19,26,29,44} Similarly, seven included studies evaluated the effects of SDOH on RCR postoperative outcomes.^{12,15,17,28,30,34,44} The average MINORS score of included studies was 14.1 ± 5.0 with comparative studies having an average score of 17.2 (range 14–19) and noncomparative studies having an average score of 7.4 (range 5–9). The nonrandomized comparative studies were of high quality and the noncomparative studies were of low quality based on the average MINORS score.

Race/ethnicity

Four studies evaluated the effects of race/ethnicity on RCR utilization,^{4,6,19,44} and two studies evaluated the effects of race/ethnicity on RCR postoperative outcomes (Table II).^{15,44} Non-White race is associated with lower odds of surgery and physical therapy (PT) utilization, as well as delayed treatment.^{4,6,15,44} Ethnicity also affects the quality of care, with Hispanic RCR patients more likely to undergo surgery with a low-volume surgeon compared to White patients who are more likely to undergo RCR with a high-volume surgeon.¹⁹ While discharge rate does not differ based on race, Black patients had worse Patient-Reported Outcome Measurement Information System (PROMIS) scores at 6-month and 1-year follow-up.^{15,44}

Insurance status

Eight studies evaluated the effects of insurance status on RCR access/utilization,^{1,6,8,19,27,29,44} and four studies evaluated the effects of insurance status on RCR postoperative outcomes (Table III).^{28,30,34,44} Public insurance, Medicare or Medicaid, is associated with decreased PT encounter billing, less PT and surgery utilization rates, decreased acceptance for postoperative PT, and a longer wait until first PT appointment.^{1,6,8,27,29} Postoperatively, public insurance is associated with worse American Shoulder and Elbow Surgeons (ASES) and PROMIS depression scores, lower return to work rates, and higher disability rates, with a trend towards worse Penn Shoulder Scores and Subjective Shoulder Scores.^{28,30,34,44}

Other

Income affects access to RCR, with patients in the lowest two income quartiles being more likely to undergo RCR with lower volume surgeons and attend lower volume facilities, while patients in the upper two income quartiles are instead more likely to undergo RCR with higher volume surgeons at higher volume facilities (Table IV).¹⁹ Achieving a higher level of education is related to greater postoperative satisfaction, ASES, and Simple Shoulder Test scores¹⁷; however, level of education and marital status were both not associated with Shoulder Pain and Disability Index scores.¹²

Discussion

The purpose of this systematic review was to evaluate the effects of SDOH on RCR utilization and postoperative outcomes in order to help orthopedic surgeons and health-care administrators recognize external factors that may influence patients' access to care and clinical outcomes. Overall, non-White race is associated with lower odds of surgery and PT utilization, as well as delayed treatment which has been shown to worsen outcomes if surgery is delayed >1 year.²¹ Similarly, public insurance is associated with lower PT and surgery utilization rates and decreased acceptance for postoperative PT. Postoperatively, public insurance is associated with worse ASES and PROMIS depression scores and lower return to work rates.

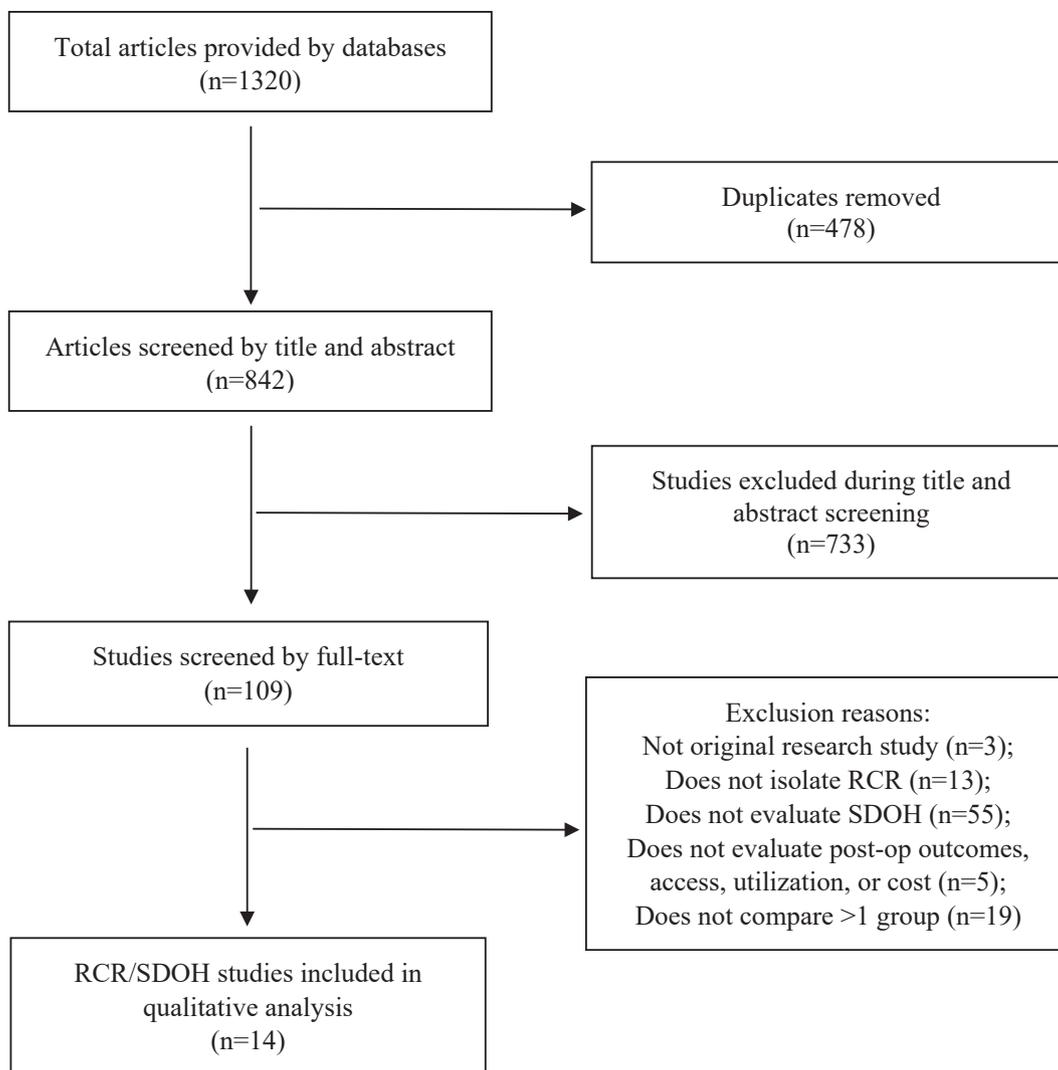


Figure 1 PRISMA flow chart of study inclusion. RCR, rotator cuff repair, SDOH, social determinants of health.

Access to orthopedic care has been previously shown to be influenced by SDOH. Insurance status and type of insurance affect access to appointments with orthopedic surgeons. Patients with Medicaid, indicative of low socioeconomic status, are more likely to be denied appointments due to lack of referral and are more likely to experience longer wait times for an appointment.⁴⁰ Within the Medicaid population, Thirukumaran et al discovered that although utilization of total hip arthroplasty has increased from 2009 to 2017, the disparities between its utilization in White and Black patients has widened and Black patients eligible for Medicaid were less likely to undergo hip replacement compared to their White counterparts.³⁶ We found these factors to similarly affect the utilization of RCR and PT.

PT practices prefer to accept RCR patients with private insurance over patients with Medicaid.^{8,29} Curry et al⁸ contacted a total of 465 different PT practices across the country, with only 52.7% accepting Medicaid compared to 94.9% accepting private insurance. Similarly, Rogers et al²⁹ found that out of 133 PT clinics, only 51.4% accepted Medicaid, while 96.4% accepted private insurance. The same study found that private insurance owners had a mean wait time of 6.3 days, while those with Medicaid had a mean wait time of 8.3 days.²⁹ This may be due

to several factors differing between Medicaid and private insurance, such as reimbursement rates and administrative burden. Additionally, access to transportation may influence utilization of PT. Factors of being a Medicaid recipient, living below the poverty threshold, and Hispanic ethnicity have greater odds of experiencing transportation barriers to accessing health care.⁴¹ Providing accessible PT for Medicaid patients is important for preventing stiffness and regaining strength throughout the postoperative timeline.⁹

Regarding race and ethnicity as SDOH, we found that there was poorer utilization and postop outcomes for patients identifying as non-White.^{4,6,15,44} Black patients consistently experience worse communication quality, information-giving, and decision-making ability with physicians when compared to White patients.³¹ These issues can result in reduced health-care utilization further compounding the effects of SDOH on health outcomes. These findings highlight the need for addressing and rectifying these systemic issues to ensure equitable health-care access and outcomes for individuals of all racial and ethnic backgrounds.

Recently, Mandalia et al²² published a study evaluating SDOH clinical outcomes of patients undergoing RCR. Although the topic

Table I
Study demographics and study quality of included studies.

Study	SDOH evaluated	Level of evidence	Sample size	% Male	Mean age (years)	Mean follow-up (years)	MINORS score
Kim 2014 ¹⁷	Education level	3	180	52.8%	62.1 ± 10.4	2.9	15
Jain 2018 ¹²	Education, marital status	2	50	62.0%	59 (52-65)	1.5	17
Arshi 2015 ¹¹	Insurance status	3	365,891	52.5%		0.04-0.5	17
Curry 2021 ⁸	Insurance status	4	467 PT practices				8
Sabesan 2017 ³⁰	Insurance status	3	29	65.51%	49.8 for medicaid and 56.9 for nonmedicaid	7.7 for medicaid and 6.5 for nonmedicaid	19
Patterson 2014 ²⁶	Insurance status	4	203 practices				8
Razmjou 2017 ²⁸	Insurance status	3	146	70.5%	52 ± 8	6-month and 1-year	19
Strotman 2020 ³⁴	Insurance status	4	84	40.5%	65.3 ± 10.4	1	19
Rogers 2019 ²⁹	Insurance status	4	138 PT clinics				5
Chapman 2018 ⁶	Insurance status, race	3	6388	57.2%	72.5 ± 4.9		14
Johnson 2022 ¹⁵	Race	3	7432	51.1%	56.9 ± 10.4		15
Bolam 2022 ⁴	Ethnicity	4	351,544 claims				7
Ziedas 2023 ⁴⁴	Race, ethnicity, insurance status, household income	3	338	53.8%	59.6 ± 8.7	1	18
Li 2019 ¹⁹	Socioeconomic status, government insurance, low income areas	4	18,616 cases	56%			9

MINORS, Methodological Index for Nonrandomized Studies; PT, physical therapy; SDOH, social determinants of health.

Table II
Outcomes of studies that evaluated race/ethnicity.

Study	Patient population(s)	Outcomes
Bolam 2022 ⁴ Chapman 2018 ⁶	Europeans and indigenous New Zealanders and Pacific People Race (Black vs. non-Black) and insurance (Medicaid vs. other)	<ul style="list-style-type: none"> Europeans had increased rates of surgeries/rehabilitations. Non-White race/Medicaid dual eligibility associated with lower odds of surgery. Black and Medicaid dual eligibility associated with lower odds of physical therapy utilization. Delayed treatment observed among Black, Hispanic, and Medicaid patients.
Ziedas 2023 ⁴⁴	White vs. black race, Hispanic/Latino vs. not Hispanic/Latino, employed vs. unemployed, private/commercial insurance vs. public/government insurance	<ul style="list-style-type: none"> White patients utilized more postoperative office visits (5.3 vs. 4.4, $P = .014$), physical therapy visits (21.3 vs. 17.6, $P = .049$), and virtual visits (3.5 vs. 2.5, $P = .004$) than black patients. Black race/lower median health income had worse Patient-Reported Outcomes Measurement Information System (PROMIS) scores at 6-month and 1-year follow-up. Black race was associated with higher PROMIS depression scores at 1 year.
Li 2019 ¹⁹	Socioeconomic status, government insurance, low-income areas	<ul style="list-style-type: none"> Hispanic patients were more likely to undergo RCR with a low-volume surgeon (high volume: 8.3% vs. low volume: 12.4%) and while White patients were less likely to undergo RCR with a low volume surgeon (79% vs. 84%) ($P < .001$).
Johnson 2022 ¹⁵	Minority vs. White	<ul style="list-style-type: none"> Minority patients had longer operative time (92 vs. 82 minutes, $P < .001$) than White patients. Inpatient (2.1% vs. 1.9%, $P = .438$) and nonhome discharge rates (0.7% vs. 0.7%, $P = .708$) were similar between groups.

is similar, many differences exist between our studies. Mandalia et al²² evaluated different SDOH such as gender, comorbidities, smoking status, place of residence, and preoperative narcotic use, whereas our study focused on SDOH outlined by the WHO. While factors such as preoperative narcotic use and smoking status have the ability to affect outcomes, they are not listed as SDOH by the WHO. Additionally, different terms and databases were used in our study, leading to differing study inclusion. However, Mandalia et al arrived at a similar conclusion that barriers to care created by SDOH result in worse clinical and patient reported outcomes in RCR.

It is important that future studies continue evaluating SDOH to further understand trends in health care. This is especially important in studies evaluating race/ethnicity, as various SDOH factors can contribute to observed health-care discrepancies. Including various SDOH in these studies, such as race and education level, can

provide a more complete analysis and produce stronger conclusions to better council the future patient population. Further research is needed to find the prevalence of rotator cuff injuries in underserved populations to also determine the true barriers to access and utilization rates of RCR. Qualitative studies should assess patient’s perception of barriers to orthopedic care to better understand where interventions may be successful in mitigating the effects of SDOH. While it is difficult to design randomized controlled trials to study the effects of SDOH on RCR access, utilization, and outcomes, studies discovering the associations between SDOH and health outcomes shed light on an important phenomenon in orthopedics and medicine in general.⁵

Future studies should address the gaps existing in the clinical literature that this study has revealed in order to standardize future analyses. The current review of the literature is limited by the low number of studies that have assessed the

Table III
Outcomes of studies that evaluated insurance status.

Study	Patient population(s)	Outcomes
Arshi 2015 ¹	United Healthcare vs. Medicare insurance	<ul style="list-style-type: none"> Increased billed PT encounters among United Healthcare group compared to Medicare group. Increased surgical repair/PT utilization rates among private insurance compared to Medicare.
Patterson 2014 ²⁶	Medicaid vs. private insurance	<ul style="list-style-type: none"> Hypothetical Medicaid patients were less likely to be offered an appointment within two weeks compared to private insurance (59% vs. 79%; $P < .001$). Medicaid patients more likely to be offered appointments in rural areas compared to urban ($P = .016$). Practices more than sixty miles from academic hospitals were more likely to accept patients with Medicaid than practices closer to academic hospitals ($P = .005$).
Chapman 2018 ⁶	Race (Black vs. non-Black) and insurance (Medicaid vs. other)	<ul style="list-style-type: none"> Non-White race/Medicaid dual eligibility associated with lower odds of surgery. Black and Medicaid dual eligibility associated with lower odds of physical therapy utilization. Delayed treatment observed among Black, Hispanic, and Medicaid patients.
Rogers 2019 ²⁹	Medicaid vs. private insurance	<ul style="list-style-type: none"> Only 51% of PT clinics accepted Medicaid for post RCR treatment while 96% accepted private insurance ($P = .019$). Medicaid patients had an 8.3 day wait time compared to a 6.4 day wait time in patients with private insurance ($P = .001$).
Ziedas 2023 ⁴⁴	White vs. black race, Hispanic/Latino vs. not Hispanic/Latino, employed vs. nonemployed, private/commercial insurance vs. public/government insurance	<ul style="list-style-type: none"> Ethnicity, employment status, and insurance status were not related to the number of health care visits.
Curry 2021 ⁸	Medicaid vs. private insurance	<ul style="list-style-type: none"> 53% of physical therapy practices accepted Medicaid insurance, compared to 95% accepting private insurance ($P < .001$). Medicaid expansion states were more likely to accept Medicaid and private insurance than nonexpansion states (Medicaid: 56% vs. 46%, $P = .05$) & (Private: 97% vs. 91%, $P = .01$). Time until first physical therapy appointment had longer variability in Medicaid expansion states (Medicaid: 0-72 days; Private: 0-43 days) than nonexpansion states (Medicaid: 0-10 days; Private: 0-11 days).
Li 2019 ¹⁹	Socioeconomic status, government insurance, low-income areas	<ul style="list-style-type: none"> Medicaid insurance added \$3864 in costs of RCR in a multivariate analysis ($P < .001$).
Razmjou 2017 ²⁸	Parallel-pay vs. public health insurance	<ul style="list-style-type: none"> Patients with parallel-pay insurance reported less disability after surgery, higher rate of minimal clinically important difference (83% vs. 45%, $P < .0001$), higher ASES scores (69 vs. 54, $P < .0001$) and were more likely to be working at 1-year follow-up (51% vs. 27%, $P < .0001$).
Strotman 2020 ³⁴	Medicare vs. private insurance	<ul style="list-style-type: none"> Preoperative ASES scores were lower among Medicaid patients compared with those with private insurance (20.4 vs. 38.8, $P = .009$). Patients with private insurance had better ASES scores at 1-year follow-up than those with Medicaid and workers' compensation (85.6 vs. 55.2 vs. 57.1, respectively, $P = .028$).
Sabesan 2017 ³⁰	Medicaid vs. Non-Medicaid	<ul style="list-style-type: none"> Both Medicaid and non-Medicaid groups showed statistically significant improvement in functional outcome scores. Non-Medicaid patients reported a trend towards better average postoperative ASES (71.3 vs. 53.7), PENN Shoulder (70.9 vs. 54.5), and Subjective Shoulder (75 vs. 60.3) scores, but none were statistically significant.

PT, physical therapy; ASES, American Shoulder and Elbow Surgeons; RCR, rotator cuff repair.

Table IV
Outcomes of studies that evaluated other social determinants of health.

Study	SDOH	Patient population(s)	Outcomes
Bolam 2022 ⁴	Deprived areas	Europeans and indigenous New Zealanders and Pacific People	<ul style="list-style-type: none"> 68% less compensation in deprived areas. Deprived areas had lower spending overall in rehabilitation, radiology, and surgery.
Chapman 2018 ⁶	Deprived areas	Race (Black vs. non-Black) and insurance (Medicaid vs. other)	<ul style="list-style-type: none"> Areas with more surgeons associated with increased rates of surgery.
Li 2019 ¹⁹	Income	Socioeconomic status, government insurance, low-income areas	<ul style="list-style-type: none"> Patients in the lowest two income quartiles were more likely to undergo RCR with lower volume surgeons and attend lower volume facilities, while patients in the upper two income quartiles instead more likely to undergo RCR with higher volume surgeons at higher volume facilities ($P < .001$).
Kim 2014 ¹⁷	Education	Worker's comp + various levels of education status	<ul style="list-style-type: none"> Lower education levels were predictors of poorer postoperative satisfaction and poorer ASES/Simple Shoulder Test scores.
Jain 2018 ¹²	Education	Various levels of education + marital status	<ul style="list-style-type: none"> Highest level of education and marital status were not found to be predictors of Shoulder Pain and Disability Index (SPADI) score at 18 months in RCR patients ($P = .79$ and $P = .22$, respectively).

RCR, rotator cuff repair; ASES, American Shoulder and Elbow Surgeons; SDOH, social determinants of health; SST, Simple Shoulder Test.

association between SDOH and RCR access and outcomes. As previously mentioned, it's important to utilize as many different scoring systems/tests as possible, considering some tests may ask biased questions, such as how often the patient is able to work full time. Furthermore, conducting a multivariate analysis whenever possible will produce stronger conclusions by accounting for factors that could influence postoperative outcomes such as age, smoking, previous surgeries, BMI, and other comorbidities.

There are several limitations to this study. Due to heterogeneity of the data, no quantitative analysis was able to be performed. Only qualitative data was reported. Additionally, there is a lack of randomized control trials regarding this subject in the literature. As a result, various studies with different level of evidence were included. To prevent further heterogeneity of the data, only RCR studies were isolated. Finally, patients in our included studies were not randomized as it is not possible to randomize participants' SDOH.

Conclusion

Various SDOH can influence access, utilization, and outcomes of RCR. Orthopedic surgeons should be aware of how factors of race and insurance type can influence a patient's treatment and recovery after RCR.

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