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Systematic Review Examining the Reporting of Race and Ethnicity in Sport-Related Concussion Studies

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Objective: Sport-related concussion (SRC) is an evolving public health concern among youth athletes. Despite emerging evidence that race and ethnicity are important factors in determining concussion outcomes, studies examining race and ethnicity are limited. We conducted a systematic review to (1) determine the prevalence of SRC studies in which participants' race or ethnicity is reported, (2) describe how race and ethnicity are used within each study, and (3) assess predictive factors for the reporting of race and ethnicity.

Data Sources: PubMed, Embase, PsycINFO, and CINAHL databases.

Study Selection: Study inclusion criteria were (1) primary and peer-reviewed research; (2) related to the diagnosis, treatment, or recovery of SRC; (3) involving school-aged athletes (ages 5 to 25); and (4) with 25 or more participants. The search was performed in March 2021 and included only studies published after March 2013.

Data Extraction: For each article, we looked at whether race and ethnicity were reported, and if so, which races or ethnicities were mentioned. For each race or ethnicity mentioned, we extracted the corresponding sample size and how they were used as variables in the study.

Data Synthesis: Of 4583 studies screened, 854 articles met inclusion criteria. Of the included articles, 132 (15.5%) reported race, and 65 (7.6%) reported ethnicity, whereas 721 (84.4%) reported neither. When examining the demographic characteristics of the 132 studies that reported race, 69.8% of athletes were White. Additionally, 79.5% of these studies used race solely as a demographic descriptor as opposed to a main exposure or covariate of interest. Studies published more recently were more likely to report race. Further, studies in specific study or journal topics and specific geographic locations of the authors were more likely to report race.

Conclusions: Reporting of race and ethnicity is limited in current SRC literature. Future authors should improve the reporting of race and ethnicity, diversify study samples by focusing on enrolling athletes from underrepresented groups, and consider the potential effect of race and ethnicity as social determinants of health on risk factors, recovery, and long-term sequelae after SRC.

Key Words: health disparities, head injuries, mild traumatic brain injury, social determinants of health

Key Points

- Over the past decade of sports concussion research, only 15.5% of included articles reported race and 7.6% reported ethnicity.
- Across all the articles that reported race, White participants represented 69.8% of the total sample size, and race most commonly was used solely as a demographic descriptor as opposed to a main exposure or covariate of interest.
- Future authors must improve the reporting of race and ethnicity and consider the potential effect they have as social determinants of health on risk factors and recovery after sport-related concussion.

Sport-related concussion (SRC) is an evolving public health concern, especially among the adolescent population. It is estimated that 1 in 5 youths playing organized sports suffers an SRC during athletic participation.[1,2] Although most concussed athletes recover within 2 weeks, 10% to 15% endure a protracted recovery.[3] Recent literature has elucidated several factors that can affect recovery after an SRC,[4,5] and although many authors have examined demographic factors such as sex and age,[6–15] few have examined associations or patterns by race and ethnicity.[6–15] Given the racial and ethnic diversity in many American sports,[16] the limited consideration of race and ethnicity in SRC research calls for further attention.[16] Health care providers and researchers involved in treating various other sport-related injuries common in American youth, from anterior cruciate ligament tears[17] to tibial

spine[18] and clavicle fractures,[19] have begun to pay growing attention to race and ethnicity. Given the large racial diversity in American sports (eg, 38% of players in the National Collegiate Athletic Association were categorized as non-White[16] in 2021), highlighting the importance of understanding race and ethnicity as social constructs that may be causal to persisting inequities in the SRC field is paramount to advancing knowledge and equity in this area.

Minoritized people have historically been discriminated against, marginalized, and underrepresented in health care research, and a growing body of science has examined the various ways in which racism can adversely affect health.[20] The persistence of racial and ethnic health inequities in the United States suggests that socioeconomic factors alone do not cause racial inequities but that there are structural determinants that often create and reinforce barriers to care by causing differential access to resources, risks, and opportunities.[20,21] With regard to SRC, previous studies have shown that race and ethnicity may be variables associated with symptom recognition,[22] care-seeking behaviors, and clinical recovery after a concussion.[23] For example, Black high school and collegiate athletes have poorer concussion symptom knowledge than their White peers.[22,24] In a study[23] completed with 577 high school athletes, Black athletes were less likely to report that a concussion had occurred during a game compared with White athletes. In other studies, Black athletes who experienced a concussion had higher symptom reporting,[25,26] slower processing speed,[25] and a higher likelihood for experiencing cognitive decline on the Immediate Post-Concussion Assessment Cognitive Test compared with White athletes.[25] Furthermore, studies have reported quicker recovery and return to school for Black and Hispanic athletes than for athletes of other races or ethnicities.[4,27] Across these published studies, it has been noted that individual- and community-level inequities are likely driving the disparities between Black and White athletes.[25,26]

Given the racial and ethnic diversity spanning across sports and early data suggesting their associations with recovery and management, race and ethnicity could be routinely reported in the sports concussion literature. At present, race and ethnicity may be inadequately reported, and an improved understanding of how and when authors report race and ethnicity in the SRC literature may promote equity and eliminate disparities within SRC research and clinical care. We conducted a systematic review on the current literature that examined SRC to (1) determine the prevalence of SRC studies that report the race, ethnicity, or both of their participants; (2) describe how race and ethnicity are used within each study; and (3) assess predictive factors for the reporting of race and ethnicity in SRC studies. It is important to note that race and ethnicity reported in the body of SRC literature we sought to investigate were in reference to the social construction rather than a biological indicator. We hypothesized that most studies would not report basic race or ethnicity demographics of the sample, would often condense minoritized races together (eg, White versus "non-White"), and would rarely use race or ethnicity as primary variables of interest.

METHODS

Literature Search Strategy

The current systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. The search was completed across the electronic databases PubMed, Embase, PsycINFO, and CINAHL to identify SRC literature related to the diagnosis, treatment, or recovery of SRC in school-aged athletes. The search was performed in March 2021 and included only studies published after March 2013. The specific date was chosen because it marked the official publication date of the 4th International Conference on Concussion in Sport.[3] Our main goal was to index the current or recent state of the literature related to its reporting of race and ethnicity. Rather than making an arbitrary cutoff (eg, "all studies from the past 10 years"), we chose to have our earliest date coincide with the most recent Concussion in Sport Group conference, as many concussion-related guidelines tend to change around that time. To maximize search strategy, the following medical subject headings (MeSH) terms were used to identify articles that had the following terms in the title or the abstract: *sport concussion*, *sport-related concussion*, *cerebral concussion*, *mild traumatic brain injury (mTBI)*. The full search terms and a summary of the process used for identifying studies through databases and registries are shown in Figure 1.

Selection Criteria

Study inclusion criteria were (1) original primary and peer-reviewed research; (2) related to the diagnosis, treatment, or recovery of SRC; (3) involved school-aged athletes (ie, ages 5 to 25); and (4) a study size greater than or equal to 25 participants. Publications that were considered reviews, nonprimary literature, nonconcussion, non-SRC, non-English or had a sample size less than 25 or predominantly outside the age range of 5 to 25 were excluded. We chose this specific age bracket because (1) SRC is most common in youths, adolescents, and young adults[28]; (2) a growing body of research on this population has surfaced in recent years[14]; and (3) our clinical practice, experience, and research focus closely on this age group. Any non-SRC study was excluded; however, in those with mixed samples (eg, a portion of the sample with SRC and a portion with orthopaedic injuries), only the SRC portion of the sample was included in the analysis.

The independent screening of all titles and abstracts was performed by a team of reviewers (J.J., K.L.W., M.A., T.A., C. Brewer, C. Burns, W.F.H., Z.S.J., A.R.T.) using the predefined inclusion and exclusion criteria. Any discrepancies were reviewed and henceforth addressed by research coordinators (K.L.W., J.W.). If disagreements still remained, the senior authors (A.M.Y.-K., S.L.Z., D.P.T.) were asked to review for further discussion until consensus was reached. Each abstract was reviewed by 2 authors. The articles identified in the initial screening underwent a full-text review with application of the inclusion criteria.

Data Extraction

The data extracted from each study that met the final inclusion criteria included the title, publication year, journal name, journal topic, author names, total sample size, sample size of concussed athletes, study design, study topic, and author and participant location. The most current impact factor was obtained for each study.[29] For each article, we looked at whether race, ethnicity, or both were

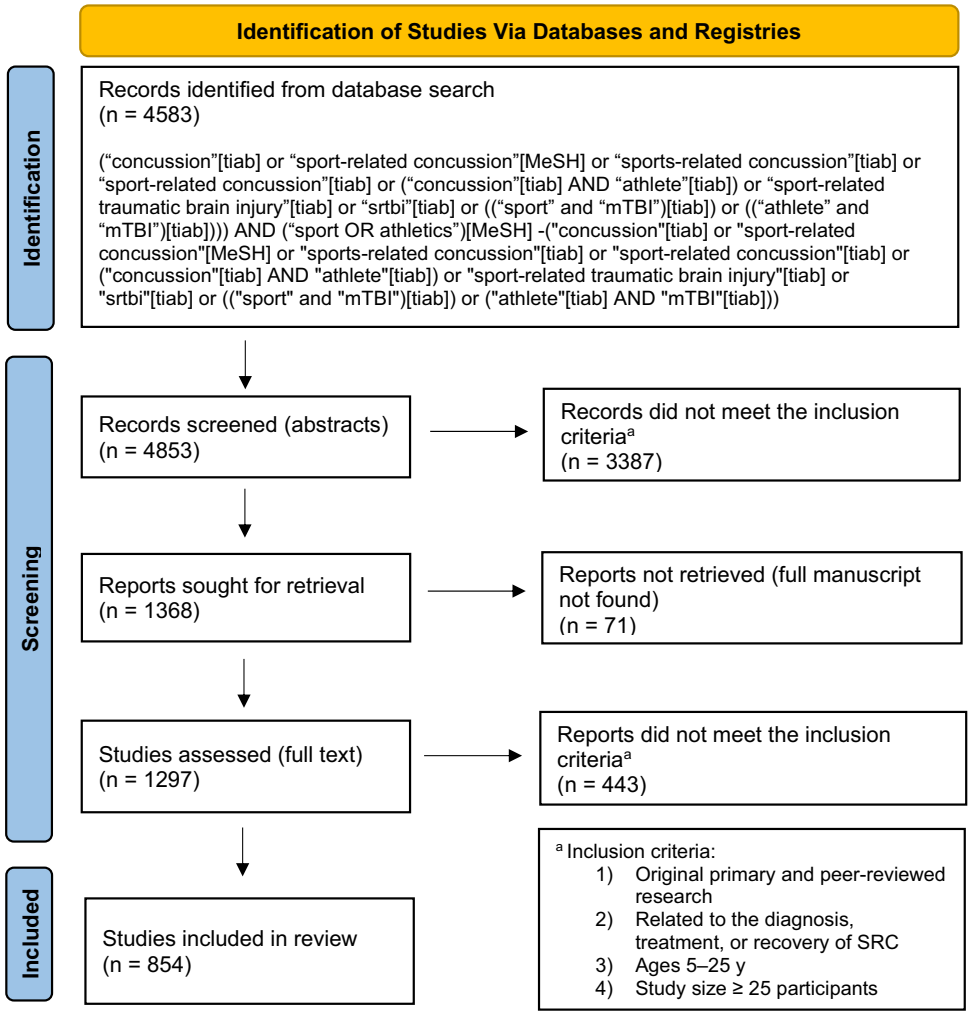

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram. Abbreviation: SRC, sport-related concussion.

reported, and if so, which races and ethnicities were mentioned. For each race mentioned, we extracted the corresponding sample size. For each study that mentioned race or ethnicity, we collected information on how they were used as variables in the study. The uses were divided into main variable of interest, covariate (race and ethnicity were part of the study's statistical analysis but not the main variable of interest), and demographic descriptor. The data sets generated, analyzed, or both during the current study are available from the corresponding author on reasonable request. The review was not registered. Unfortunately, by the time we had begun our study, the appropriate time for registration (ie, at the inception/protocol stage) had already passed; therefore, the study was continued without official registration. A full taxonomy of options for each variable (ie, journal topic, study topic, study design, author and participant location, use of variable) and instructions for data extraction (eg, how to categorize each US state, specific journals that should go under each category) are included in Supplemental Tables 1 and 2 (available online at https://dx.doi.org/10.4085/1062-6050-0072.23.S1), respectively.

Statistical Analysis

Descriptive statistics were calculated to present the total number of articles that reported race, ethnicity, or both and the characteristics of total articles and only those that reported race, ethnicity, or both. Univariate and multivariable logistic regressions were run to evaluate the predictive factors among the descriptive variables that might be associated with reporting of race versus not reporting race. All variables included in the univariate analysis were included in the multivariable analysis. Variables including journal topic, study topic, author and participant locations, and study design were treated as categorical variables and the year of publication and impact factors as continuous variables. For our logistic regression analyses, journal topic was recategorized into 4 subcategories: clinical sports, general medicine, head trauma/rehabilitation, and neuro-related. Significance was determined based on $P < .05$. IBM SPSS Statistics (IBM Corp) was used for all analyses.

RESULTS

Reporting of Race and Ethnicity

Of 4583 studies screened, 854 articles met inclusion criteria. Of the included articles, 132 (15.5%) reported race and 65 (7.6%) reported ethnicity, whereas 721 (84.4%) reported neither. All of the studies that reported ethnicity (n = 65, 100.0%) also reported race.

Table 1. Journal and Study Topics of Total Articles and Articles That Reported Race

Areas of Study	Total Articles, No. (%), N = 854	% Race Reported, No./Total (%), n = 132/854
Journal topic		
Biomechanics/kinesiology	23 (2.7)	3/23 (13.0)
Clinical sports medicine/athletic training	303 (35.5)	25/303 (8.3)
General pediatrics	73 (8.5)	13/73 (17.8)
Head trauma/rehabilitation	164 (19.2)	30/164 (18.3)
Health disparities/public health	13 (1.5)	4/13 (30.8)
Medicine	83 (9.7)	16/83 (19.3)
Neurology/psychiatry	93 (10.9)	17/93 (18.3)
Neuropsychology	72 (8.4)	20/72 (27.8)
Neurosurgery	30 (3.5)	4/30 (13.3)
Study topic		
Descriptive epidemiologic study	126 (14.8)	25/126 (19.8)
Diagnostics/biomechanical/kinesiology	177 (20.7)	36/177 (20.3)
Neurocognitive/baseline testing	55 (6.4)	5/55 (9.1)
Postconcussion syndrome/symptoms	138 (16.2)	15/138 (10.9)
Recovery	316 (37.0)	45/316 (14.2)
Treatment/intervention	42 (4.9)	6/42 (14.3)

Table 2. Author and Participant Locations and Study Designs of Total Articles and Articles That Reported Race

Geography/Study Design	Total Articles, No. (%), N = 854	% Race Reported, No./Total (%), n = 132/854
Author location		
US Midwest	169 (19.8)	39/169 (23.1)
US Northeast	219 (25.6)	33/219 (15.1)
US South	152 (17.8)	39/152 (25.7)
US West	108 (12.6)	19/108 (17.6)
Outside United States	206 (24.1)	2/206 (1.0)
Participant location		
US Midwest	159 (18.6)	37/159 (23.3)
US Northeast	232 (27.2)	33/232 (14.2)
US South	139 (16.3)	35/139 (25.2)
US West	85 (10.0)	17/85 (20.0)
Outside United States	239 (28.0)	10/239 (4.2)
Study design by type		
Case series	6 (0.7)	0/6 (0.0)
Case-control	107 (12.5)	16/107 (15.0)
Cohort	432 (50.6)	71/432 (16.4)
Cross-sectional	227 (26.6)	31/227 (13.7)
Descriptive epidemiologic	62 (7.3)	9/62 (14.5)
Randomized controlled trial	20 (2.3)	5/20 (25.0)
Study design by time		
Retrospective	474 (55.5)	76/474 (16.0)
Prospective	380 (44.5)	56/380 (14.7)

Description of Articles That Reported Race

Of the 132 articles that reported race, 8 studies (6.1%) reported that 100% of their sample was White, 10 studies (7.6%) reported their sample comprised both White and Black participants, 22 studies (16.7%) reported their sample comprised White and "other" participants, and the remaining studies reported their sample comprised multiple distinct racial groups in various permutations. Across the 132 studies that reported race, a total of 308 085 participants were examined. Of those, 214 981 (69.8%) were White, 51 497 (16.7%) Black, 6277 (2.0%) Asian, 754 (0.2%) Pacific Islander, 888 (0.3%) Native American, and 33 688 (10.9%) categorized as other, unspecified, or missing. Across the 65 studies that reported ethnicity and a total number of 261 591 participants examined, 38 965 (14.9%) were noted to be Hispanic or Latino. For this portion of the analysis, 2 studies[30,31] were excluded (despite meeting our inclusion criteria) because they were large-scale studies that reported race and ethnicity of very large populations. Although these 2 studies met our inclusion criteria and were included in all other analyses, we thought they would unduly influence our data for this portion only, as these 2 studies alone would affect our proportions significantly.

The 132 articles that reported race showed a variation in distribution based on the area of study, geographic location of author and participant, and study design. Among the various journal topics, health disparities/public health had the highest percentage of total articles that reported race (ie, 4 of the 13 studies in this category reported participants' race, 30.8%), and clinical sports medicine/athletic training had the lowest (25 of 303, 8.3%; Table 1). Within the different study topics, diagnostics/biomechanical/kinesiology had the highest percentage of articles that reported race (36 of 177, 20.3%) and neurocognitive/baseline testing, the lowest (5 of 55, 9.1%; Table 1). When looking at both author location (39 of 152, 25.7%) and participant location (35 of 139, 25.2%), the US South had the highest reporting of race compared with other regions of the United States. For both author location (2 of 206, 1.0%) and participant location (10 of 239, 4.2%), regions outside the United States had the lowest reporting of race (Table 2). Finally, when looking at study design by type, randomized controlled trials had the highest percentage of articles that reported race (5 of 20, 25.0%), and case series had the lowest (0 of 6, 0.0%). The percentage of articles in which race was reported did not differ significantly between retrospective and prospective studies (Table 2).

Statistical Uses of Race and Ethnicity

Among the 132 articles that reported race, race was reported solely as a demographic descriptor in 105 (79.5%). Race was used as a main exposure of interest in 9 of the 132 studies (6.8%) and a covariate in 4 studies (3.0%). Of the 65 articles that reported ethnicity, ethnicity was used solely as a demographic descriptor in 55 (84.6%). In the remainder of the articles, ethnicity was used as a main exposure of interest in 5 of the 65 studies (7.7%) and a covariate in 4 (6.2%; Table 3).

Table 3. Uses of Race and Ethnicity Among Articles That Reported Race or Ethnicity

Use of Variable	Use of Race, No. (%), n = 132	Use of Ethnicity, No. (%), n = 65
Covariate	4 (3.0)	4 (6.2)
Demographic descriptor	105 (79.5)	55 (84.6)
Main exposure of interest	9 (6.8)	5 (7.7)
Other	14 (10.6)	1 (1.5)

Table 4. Univariate and Multivariable Logistic Regressions Showing the Potential Predictors for Reporting Race[a,b]

	Univariate		Multivariable	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Journal topic[a]				
Clinical sports (ref)				
General medicine	2.58 (1.50–4.44)	**<.001**	3.22 (1.78–5.80)	**<.001**
Head trauma/rehabilitation	2.38 (1.37–4.15)	**.002**	2.91 (1.61–5.25)	**<.001**
Neuro-related	2.83 (1.69–4.76)	**<.001**	3.78 (2.16–6.64)	**<.001**
Study topic				
Descriptive epidemiologic study (ref)				
Diagnostics/biomechanical/kinesiology	1.03 (0.58–1.83)	.915	0.77 (0.37–1.62)	.494
Neurocognitive/baseline testing	0.40 (0.15–1.12)	.081	0.35 (0.11–1.09)	.07
Postconcussion syndrome/symptoms	0.49 (0.25–0.98)	**.045**	0.40 (0.17–0.93)	**.034**
Recovery	0.67 (0.39–1.15)	.147	0.45 (0.22–0.92)	**.027**
Treatment/intervention	0.67 (0.26–1.77)	.424	0.46 (0.15–1.46)	.187
Author location				
US Midwest (ref)				
US Northeast	0.59 (0.35–0.99)	**.046**	0.90 (0.22–3.68)	.886
US South	1.15 (0.69–1.92)	.59	1.81 (0.47–7.05)	.39
US West	0.71 (0.39–1.31)	.275	0.60 (0.12–2.98)	.532
Outside United States	0.03 (0.01–0.14)	**<.001**	0.03 (0.01–0.19)	**<.001**
Participant location				
US Midwest (ref)				
US Northeast	0.55 (0.33–0.92)	**.023**	0.62 (0.15–2.57)	.505
US South	1.11 (0.70–0.65)	.701	0.69 (0.17–2.82)	.606
US West	0.82 (0.43–1.57)	.558	1.27 (0.24–6.76)	.776
Outside United States	0.14 (0.07–0.30)	**<.001**	0.79 (0.25–2.46)	.679
Study design				
Case-control (ref)				
Case series	0.00 (0.00–0.00)	.999	0.00 (0.00–0.00)	.999
Cohort	1.12 (0.62–2.02)	.709	1.04 (0.54–1.98)	.912
Cross-sectional	0.90 (0.47–1.73)	.751	0.77 (0.38–1.56)	.463
Descriptive epidemiologic	0.97 (0.40–2.34)	.939	0.36 (0.11–1.15)	.084
Randomized controlled trial	1.90 (0.60–5.95)	.273	1.76 (0.48–6.44)	.392
Year of publication	1.08 (0.99–1.18)	.076	1.14 (1.03–1.25)	**.008**
Impact factor	1.03 (1.00–1.06)	**.048**	1.03 (1.00–1.07)	.093

Abbreviations: OR, odds ratio; ref, reference variable.

[a] Clinical sports = biomechanics/kinesiology, clinical sports medicine/athletic training; general medicine = general pediatrics, health disparities/public health, medicine; neuro-related = neurology/psychiatry, neuropsychology, neurosurgery.

[b] Bolded values denote statistical significance.

Predictive Factors for Reporting Race, Univariate Logistic Regression

In univariate analyses, journal topic was a significant predictor for reporting race, such that studies published in journals that focused on general medicine, head trauma/rehabilitation, and neurologic topics were more likely to report race compared with clinical sports journals. Pertaining to study topic, studies in the postconcussion syndrome/symptoms category were less likely to report race compared with descriptive epidemiologic studies. Studies published in journals with higher impact factors were more likely to report race. Regarding study location, as compared with the US Midwest, studies published in the US Northeast and outside the United States were less likely to report race. Study design and year of publication were not significant predictors for reporting race (Table 4).

Predictive Factors for Reporting Race, Multivariable Logistic Regression

For the multivariable analysis, journal topic was a significant predictor for reporting race, with general medicine (odds ratio [OR] = 3.22, $P < .001$; 95% CI = 1.78, 5.80), head trauma/rehabilitation (OR = 2.91, $P < .001$; 95% CI = 1.61, 5.25), and neuro-related (OR = 3.78, $P < .001$; 95% CI = 2.16, 6.64) more likely to report race than clinical sports. For study topic, studies of postconcussion syndrome/symptoms (OR = 0.40, $P < .034$; 95% CI = 0.17, 0.93) and recovery (OR = 0.45, $P < .027$; 95% CI = 0.22, 0.92) were less likely to report race than descriptive epidemiologic studies. Impact factor was no longer statistically significant in the multivariable model. Geography was a predictor for reporting race, with authors who were outside the United States less likely to report race (OR = 0.03, $P < .001$; 95% CI = 0.01, 0.19). Studies published in more recent years were more likely to report race (OR = 1.14, $P < .008$; 95% CI = 1.03, 1.25; Table 4; Figure 2).

DISCUSSION

Given the diverse racial and ethnic representation in sport and the relatively scarce inclusion of race and ethnicity within SRC literature, we performed a systematic review of the current SRC literature to determine the proportion of studies that reported race, ethnicity, or both;

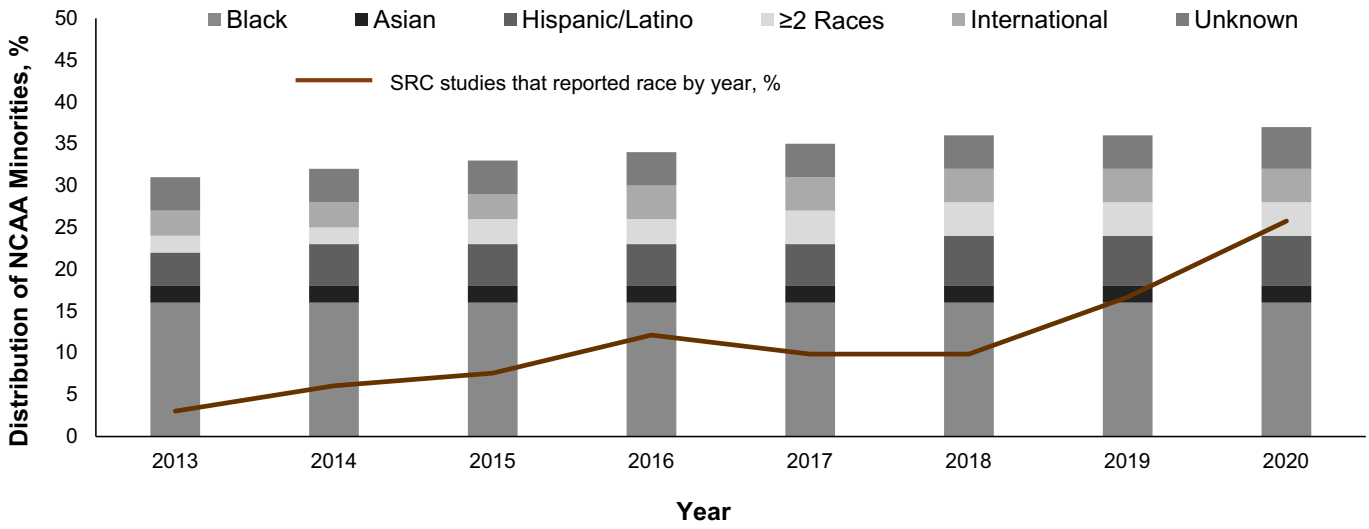

Figure 2. Percentage of racial and ethnic minorities in US collegiate athletes and percentage of studies reporting race by year. Abbreviations: NCAA, National Collegiate Athletic Association; SRC, sport-related concussion.

describe how they were used; and assess the factors associated with their mention. Of all included articles, only 15.5% reported race and 7.6% reported ethnicity, whereas 84.4% reported neither. Across all the articles that reported race, people who identified as White represented more than two-thirds of the total sample size, and race was mostly used as a demographic descriptor. Factors associated with reporting race included study topic, journal topic, year of publication, and author location. To our knowledge, this is the first study that has quantified the frequency with which race and ethnicity variables were reported in SRC literature. We believe that our review presents an important analysis of the current status of race and ethnicity reporting in SRC literature and provides a foundation from which areas of improvement can be identified.

Of all included studies, fewer than 1 in 5 articles reported their participants' race, and only 1 in 10 reported ethnicity. Despite the robust literature evaluating demographic variables associated with directional patterns of recovery, such as age and biological sex,[6–15] there is a paucity of studies investigating race and ethnicity. More recently, authors have commented on the dearth of consideration for race and ethnicity in the sports concussion research space. In a study on the associations between concussion, race and ethnicity, and mental health symptoms, Eagle et al[32] discussed the difficulty in estimating the rate of concussion in each race or ethnicity because many studies contain small sample sizes of minoritized people. Further, both Yengo-Kahn et al[27] and Holmes et al[26] discussed the lack of SRC studies that include race and ethnicity data on their participants. Our findings confirm these prior conclusions and demonstrate the lack of research inclusive of race and ethnicity.

As previously noted, several SRC studies have shown that race and ethnicity may be significant variables associated with symptom recognition,[22] care-seeking behaviors, and clinical recovery after an SRC.[23] Black high school athletes having poorer knowledge of concussion symptoms,[23] we hypothesize, may highlight inequities and differences in concussion education and environmental support. Black high school and collegiate[23] and youth athletes[24] having higher symptom reporting[25,26] could possibly indicate the role of medical jargon, inequitable access to concussion screening tools, and sociocultural context in symptom expression, recognition, and communication. With respect to recovery, Black and Hispanic athletes demonstrating earlier return to school[4,27] may speak to inequitable access to care and management during recovery. These findings appear to align with prior literature in other health domains, such as psychiatry, that highlight the differences in social determinants of health based on race and ethnicity, in which disorders such as depression are reported to be more frequent[33] and disabling[34] for members of minoritized groups than for White individuals because of potential sociocultural, economic, and access factors.[35,36] The aforementioned factors may contribute to how an athlete presents to a health care professional and in turn may directly influence the athlete's management.[4,27] Therefore, the current lack of reporting and investigation of race and ethnicity in SRC studies may result in poor evidence-based care available to minoritized athletes. The presence of racial and ethnic health inequities across the United States is not a singular result of socioeconomic differences but is also a consequence of persisting structural social determinants that propagate barriers to access to care[20,21]; therefore, race and ethnicity must be appropriately examined in this context.

The current results showed that predictors for reporting race included study topic, journal topic, year of publication, and author location. When considering study topic, studies of postconcussion syndrome/symptoms and recovery were less likely to report race when compared with descriptive epidemiologic studies. This phenomenon made reasonable sense, as large epidemiologic studies would be more likely to use race when describing the sample because those studies typically use large, publicly available data sets that are more widely representative of the national population. With regard to journal topic, studies in journals that fit the clinical sports category were least likely to report race as opposed to other topics. Though we can formulate conjectures, including rapidly growing attention in recent years to race and ethnicity in certain health domains (eg, general medicine, cardiology, psychiatry), to explain this finding, it is difficult to ascertain which of them are truly applicable. Studies published more recently were more likely to report race. The racial and ethnic minorities in youth sports, as

reported by the National Collegiate Athletic Association demographics database,[16] are increasing by year and have always made up greater than 30% of athletes, and the number of studies reporting race is increasing to match the percentage of minoritized athletes (Figure 2). This finding is in alignment with the growing attention of race and ethnicity as variables in management and outcomes after SRC in recent literature. Finally, author location was a significant predictor for reporting race, with United States authors more likely to report race than those in regions outside the United States. In the United States, race and ethnicity are complex social determinants of health, encompassing various aspects of community and population health, education, and economics.[27] Although we recognize the nuanced nature of the subject, the intricate role race plays in US culture may ascribe to its greater prevalence in studies originating from the United States when compared with those from outside the United States. Structural racism in the contemporary United States continues to contribute to racial discrimination across sectors of politics and policymaking, education, income, employment, and health.[37] In the same vein, the way race and ethnicity are conceptualized in the context of society may be different in regions outside the United States when compared with the United States, leading authors not to report it. With this in mind, although we excluded non-English literature from our study, we hypothesize that the prevalence of studies reporting race and ethnicity might have been even lower if we had included studies of all languages. Given the unique role race and ethnicity may play in America, non-English studies may not have been applicable due to the context of our study and the way we have conceptualized race and ethnicity.

Race and ethnicity are social and political constructs that have stratified groups of people despite a lack of biological differences[38] and continue to play a major role in one's health.[39] Current literature contains overwhelming evidence of race and ethnicity being significantly associated with adverse health outcomes across multiple organ systems and illnesses, from cardiac,[40,41] renal,[42] and pulmonary[43] to psychiatric.[44,45] Today, emerging literature shows that head injury and concussions are no different.[23] However, the current literature on SRC falls short on investigating race and ethnicity as variables that may have notable bearing on risk factors, symptoms, and recovery after a concussion. Moreover, the majority of SRC studies to date fail to report race and ethnicity as basic descriptive demographics. Our systematic review provides an insight into an area that needs urgent attention in SRC literature, as the shortcomings identified may have a direct effect on the quality of care a patient receives after an SRC. Underscoring this gap in literature may provide solutions to fixable problems with attainable changes. When discussing race and ethnicity, the appropriate use of terminology, definitions, and language is of utmost importance to ensure diversity and inclusivity of all populations in conversation.[38] To improve education, care, and access to care for SRC and reduce unintentional bias in scientific literature, we recommend that future authors (1) report the race and ethnicity of their sample population; (2) investigate how race and ethnicity play a role in SRC risk factors, recovery, and long-term sequelae; (3) include samples that have a larger minority presence; and (4) discuss how race and ethnicity influence home and parental factors among athletes with SRC. In this way, race and ethnicity can be better explored in the context of sociodemographic variables and modifiable factors that are closely intertwined with social determinants of health.[38]

The study had several limitations. First, we specifically examined prior studies involving people with concussion and therefore excluded all studies that examined healthy athletes at preseason baseline. As the concussion literature encompasses numerous baseline (ie, preinjury) studies, our results may not be generalizable to the entire concussion literature to date. Although we chose to exclude baseline studies in this review to focus exclusively on those with SRC rather than all who participated in sports, we encourage future efforts to further investigate the reporting of race and ethnicity in baseline SRC studies to better characterize the literature as a whole. Second, we understand that demographics of a study sample tend to mirror those of the population and location in which the study takes place. Although we believe that race and ethnicity should be reported and studied more frequently in future studies, we recognize the limitations imposed by the population demographics based on region and that some authors may not have much racial and ethnic diversity in their community. We strongly believe investigators should strive for study populations that reflect the diversity of the local young athlete population. Lastly, our categories of journal and study topics were created and modified based on our understanding of the breadth of current SRC literature; therefore, there is notable subjectivity in the groupings used, and a different set of categories might have resulted in different logistic regression results.

CONCLUSIONS

Race and ethnicity are important variables to better understand incidence and outcomes after SRC, but limited research includes them. Over the past decade of sports concussion research, 15.5% of included articles reported race and 7.6% reported ethnicity. Across all the articles that reported race, White people represented 69.8% of the total sample size, and race most commonly was used as a demographic descriptor. Factors associated with reporting race included study topic, journal topic, year of publication, and author location. Our review spotlights a major gap in reporting and underappreciation of the potential implications of race and ethnicity in SRC literature. Future authors must improve the reporting of race and ethnicity, diversify study samples by focusing on enrolling athletes from underrepresented groups, and consider the potential effect of race and ethnicity as social determinants of health on risk factors, recovery, and long-term sequelae after SRC.

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SUPPLEMENTAL MATERIAL

Supplemental Table 1. Taxonomy of Options for Data Extraction.
Supplemental Table 2. Data Extraction Instructions.
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