

# Does the Association Between Concussion Measures and Social Context Factors Differ in Black and White Parents?

Alicia M. Montalvo, PhD, MPH, LAT, ATC\*†‡; Jessica S. Wallace, PhD, MPH, LAT, ATC‡; Aliza K. Nedimyer, PhD, LAT, ATC§; Avinash Chandran, PhD, MS¶||; Melissa K. Kossman, PhD, LAT, ATC¶||; Paula Gildner, MPH\*\*; Johna K. Register-Mihalik, PhD, LAT, ATC§\*\*; Zachary Yukio Kerr, PhD, MPH§\*\*

\*College of Health Solutions, Arizona State University, Phoenix; †Emory Sports Performance and Research Center, Flowery Branch, GA; ‡Department of Health Science, University of Alabama, Tuscaloosa; §Department of Exercise and Sport Science, University of North Carolina at Chapel Hill; ||Datatlys Center for Sports Injury Research and Prevention, Indianapolis, IN; ¶School of Health Professions, University of Southern Mississippi, Hattiesburg; #Sports Medicine and Community Health Research Lab, University of Southern Mississippi, Hattiesburg; \*\*Injury Prevention Research Center, University of North Carolina at Chapel Hill

**Context:** Middle school (MS) parents may benefit from education supporting timely concussion identification and care-seeking in their young children (aged approximately 10 to 15 years). However, such education may not consider individual needs and different social context factors, including lower socioeconomic status, disadvantaged social determinants of health, and different racial and ethnic backgrounds.

**Objectives:** To examine the relationship between social context factors and concussion knowledge, attitudes, and communication in MS parents and to explore the possible role of race and ethnicity (Black or White) as an effect measure modifier.

**Design:** Cross-sectional study.

**Setting:** Online survey.

**Patients or Other Participants:** A nationally representative sample of MS parents who completed an online survey (n = 1248).

**Main Outcome Measure(s):** Parent outcomes were a history of concussion education, concussion symptom knowledge and attitudes, and communication with children about concussion.

Main exposures were parental race and ethnicity (Black or White) and social context factors. Uni- and multivariable statistical analyses were performed to achieve the study aims.

**Results:** Black parents were more likely than White parents to have received concussion education (69.5% versus 60.5%,  $P = .009$ ), although median concussion knowledge scores were higher for White parents than for Black parents (40 versus 37,  $P < .001$ ). Few associations were found for social context factors with concussion knowledge, attitudes, and communication in Black and White parents separately.

**Conclusions:** Among MS parents, race and ethnicity may not influence the association between social context factors and concussion-related knowledge, attitudes, or communication. However, differences were present by race and ethnicity regarding previous concussion education and other parental outcomes, concussion symptom knowledge in particular.

**Key Words:** socioeconomic status, race, ethnicity, adolescents, social determinants of health

## Key Points

- Black parents were more likely than White parents to have received concussion education.
- White parents had higher concussion knowledge scores than Black parents.
- Social context factors did not play a significant role in concussion-related knowledge, attitudes, or communication.

Approximately 1.1 to 1.9 million youth in the United States under the age of 18 years are estimated to sustain a sport- or recreation-related concussion annually.<sup>1</sup> Concussions are a public health concern that require continued intervention to ensure proper prevention, diagnosis, and management. Concussion injury reporting and care-seeking are influenced by concussion knowledge and attitudes.<sup>2,3</sup> According to the socioecological model, interpersonal relationships, such as the relationship between parents and

children, affect concussion behaviors.<sup>4,5</sup> Education programs to improve parental concussion knowledge and attitudes are important because parents act as health care gatekeepers for children, and poor knowledge and care-seeking attitudes may interfere with care-seeking behavior.<sup>6</sup> Recognizing that a child needs care is a parent's responsibility, especially when the child is unaware of a concussion or its associated symptoms. Thus, parents should be knowledgeable about concussions given their role in their children's medical decision-making.

Although many parents may receive concussion education, such education may not consider the needs of all individuals, including those with a lower level of health literacy, those of lower socioeconomic status (SES), or those of different cultural or racial backgrounds.

Growing evidence suggests that social determinants of health (SDOH) are important considerations to reduce health disparities and inequities.<sup>7</sup> The 5 SDOH are educational access and quality, economic stability, neighborhood and built environment, health care access and quality, and social and community contexts.<sup>8</sup> Social determinants of health are useful for examining nonmedical factors that influence one another and health, including knowledge, attitudes, and behaviors.<sup>7</sup> Individuals who are socially disadvantaged regarding SDOH (usually those with lower SES) have worse health outcomes than individuals with access to more resources.<sup>7</sup> In general, higher income, a suburban environment, and higher parental educational achievement (factors often related to higher SES) are associated with more favorable concussion knowledge, attitudes, and behaviors.<sup>9-12</sup>

Disparities in social context factors, including SES and SDOH, often produce differences in health measures, such as concussion-related knowledge, among racial and ethnic groups because racial and ethnic minoritized people, including Black and Hispanic people, are disproportionately affected by low SES compared with White people.<sup>13</sup> Black people are 4 times more likely to experience poverty than White people,<sup>14</sup> and Hispanic people are 2 times more likely than White people to experience poverty.<sup>15</sup> Because of the illustrated gaps in social context factors, disparities may vary within different racial and ethnic groups. As a result, it is important to account for race and ethnicity and social context factors when attempting to understand potential contributors to disparities.

Understanding where disparities exist in parental knowledge and attitudes pertaining to concussion is critical for creating effective concussion education programs to enhance care-seeking in parents and improve concussion reporting in children. Tailoring concussion education programs for people of different SES, SDOH, and race and ethnicity may be necessary, although little evidence regarding the role of these factors on concussion knowledge and attitudes in parents of middle school (MS) children is available. Therefore, we used a secondary data analysis of a national survey of parents of MS-aged children (aged approximately 10 to 15 years) to examine the relationship between social context factors and concussion knowledge, attitudes, and communication and to explore the possible role of race and ethnicity (Black or White) as an effect measure modifier.

## METHODS

This study was a secondary data analysis using cross-sectional survey data collected from a sample of parents of MS-aged children.<sup>16</sup> Exposures related to SES and SDOH that were available from the data were grouped to derive the term *social context factors*. Additional analyses to determine whether race and ethnicity (Black or White) was an effect measure modifier were performed. The study was approved by the Institutional Review Board at the University of North Carolina - Chapel Hill. All participants provided written informed consent before the study.

## Participants and Sampling

The original study authors partnered with Survey Sampling International (SSI; Dynata, LLC) to obtain their nationally representative sample. Survey Sampling International recruited US residents who agreed to participate in online survey research. The participant pool provided demographic information from which SSI identified those eligible for specific studies. Survey Sampling International ensured data quality through certification processes, including digital fingerprinting, Internet Protocol verification, and built-in quality control questions. When members of the participant pool completed the surveys, SSI reimbursed them with reward points that could be redeemed for incentives.

For the original study, SSI first identified individuals in their participant pool who had previously reported being a parent of a child aged 10 to 15 years (the approximate age of MS students). No other exclusion criteria were used. Among eligible participants, SSI randomly generated a sample that received an invitation to engage in the study. The invitation asked participants to “take a survey” and omitted specific study details until after the individual accepted the invitation.

Survey Sampling International invited 1362 people who met the inclusion criteria (ie, US residents aged  $\geq 18$  years who identified as parents of children aged 10 to 15 years) to complete the questionnaire in October 2018. To capture all potential guardians, the age range for eligible participants was expanded to allow for the inclusion of younger ages, defined here as *parents*. Of those invited, 1248 (91.6%) had children currently enrolled in MS, completed the questionnaire, self-identified as either Black or White, and were included in the analyses.

## Data Collection

Participants completed an online questionnaire hosted by Qualtrics. The questionnaire was developed using feedback from the parents of youth athletes, injury epidemiologists, and sports medicine professionals and was previously validated and piloted in a sample of MS parents.<sup>16,17</sup> In addition to concussion-related measures, the questionnaire included items to examine parent and MS child characteristics. The questionnaire was integrated into the SSI survey platform to be distributed to and completed by participants.

## Measures

**Exposures.** The exposures of interest related to SES and SDOH were categorized as social context factors. These were whether participants reported being of Spanish origin (non-Hispanic or Hispanic), their highest education level (less than a bachelor’s degree, bachelor’s degree, or more than a bachelor’s degree), and the MS child’s school designation (public or private). Community-level factors related to social context were the percentage of residents in the zip code over the age of 25 years with at least a bachelor’s degree, the percentage of residents in the zip code who were from racial or ethnic minoritized groups, and the percentage of households in the zip code below the poverty line. We selected these exposures because they are related to SES or the community context portion of SDOH, both of which are known to influence health outcomes.<sup>7</sup>

**Effect Measure Modifier.** Race and ethnicity (Black or White) was examined as a possible effect measure modifier for the association between social context factors and knowledge,

attitudes, and communication about concussion in parents of MS children.

**Parental Outcomes.** In total, 4 primary parental outcomes were of interest, with an additional 7 secondary parental outcomes. These parental outcomes were associated with concussion knowledge (2 primary and 2 secondary), attitudes (1 primary and 5 secondary), and communication (1 primary). *Primary measures* were those that directly measured the outcomes of interest, whereas *secondary measures* were subsets of larger instruments whose components measured the outcomes of interest.

**Concussion Knowledge.** The 2 primary knowledge outcomes were a history of concussion education and concussion symptom knowledge. A history of concussion education was assessed as whether the participant had reported previous concussion education (since 2017; *yes* or *no*). Concussion symptom knowledge<sup>16</sup> determined the correct identification of 25 concussion symptoms on a 50-point scale to which participants could respond *yes*, *no*, or *maybe*. Correct responses scored 2 points, *maybe* responses scored 1 point, and incorrect responses scored 0 points. A higher score indicated greater symptom knowledge.

Two secondary knowledge items were scored using a 4-point Likert-type scale ranging from *strongly agree* to *strongly disagree*. These items evaluated parents' applied knowledge of procedures after concussion. The first item asked whether parents agreed with the statement, "As long as symptoms resolve within 15 minutes, a middle school student who exhibits any signs or symptoms consistent with concussion can be returned to physical activity on the same day." The second item asked whether parents agreed with the statement, "A middle school student exhibiting signs and symptoms consistent with concussion should complete a return to physical activity protocol before returning to physical activities (eg, PE [physical education])." These secondary items were retained as singular ordinal measures in analyses rather than computing scales.

**Concussion Attitudes.** The 1 primary attitude outcome was concussion care-seeking. This measure consisted of 5 items scored on a 7-point Likert scale and evaluated parents' attitudes about seeking care if they thought their MS child had sustained a concussion, ranging from *strongly agree* to *strongly disagree*.<sup>16</sup> The scale was scored from 5 to 35, with higher scores indicating more favorable care-seeking attitudes.

In addition to the primary measure, 5 secondary attitude items were scored using a 7-point Likert-type scale ranging from *strongly agree* to *strongly disagree*. These attitude items were a focus on concussion in sports, the long-term effects of concussion, MS student concussion knowledge, MS staff concussion knowledge, and MS parental concussion knowledge. These secondary items were retained as singular ordinal measures in analyses rather than computing scales.

**Concussion Communication.** The final primary measure was a communication-related measure regarding how frequently parents generally communicated with their MS child about concussion. The item was scored on a 5-point scale ranging from *never* to *always*. This measure was retained as a singular ordinal measure in analyses rather than computing scales.

**Covariates.** Additional covariates examined parental and MS child characteristics. Parental characteristics were sex (male versus female), parent personal concussion history (*yes* versus *no*), and parent age in years (retained as a discrete measure). The child characteristics were the child's personal

concussion history (*yes* versus *no*) and if the child played sports in the last year (*yes* versus *no*). If participants had multiple children in MS, they were asked to respond to questions in aggregate.

## Statistical Analysis

We analyzed the data using SAS (version 9.4; SAS Institute). Descriptive analyses, including frequencies and measures of central tendency and variability for quantitative variables, were conducted for all measures of interest. Next, distributions of all variables were compared by race and ethnicity (Black or White) using  $\chi^2$  tests for nominal variables, Wilcoxon rank-sum tests for quantitative variables, and mean score statistics for ordinal variables.

Finally, we computed multivariable regression models to assess the social context variables and covariates associated with the primary parent outcomes of interest. To characterize the effect measure modification by race and ethnicity, separate models were run for Black and White participants. For previous concussion education, a logistic regression model was run predicting the odds of having previous education. Ordinal logistic regression models predicted the odds of higher levels of concussion symptom knowledge and care-seeking attitudes as a function of the exposures of interest. Given the discrete nature of knowledge and attitudes, we decided to categorize scores into 3 ordinal levels based on approximately 33% increments in the overall range of each score (ie, knowledge = 0 to 16, 17 to 33, and 34 to 50; attitudes = 5 to 15, 16 to 25, and 26 to 35). These models met the proportional odds assumption. Finally, for concussion communication, ordinal logistic regression models predicted higher-frequency communication with MS children. A decision was made to categorize responses into *never/rarely*, *a few times/sometimes*, and *always* to aid statistical power regarding the distribution of responses. Proportional odds assumptions were met for the model focused on White participants but not for Black participants. Further model building exploration revealed that using a partial proportional odds model to separate effect estimates for personal concussion history resolved the concern (ie, 2 discrete effect estimates were generated to [1] compare the odds of always talking about concussion with MS children between those with and those without a history of concussion and [2] compare the odds of never/rarely talking about concussion between those with and those without a history of concussion).

Adjusted odds ratios (aORs) were computed for age (maintained as a discrete variable, examining the effects of 10-year increases), sex (female versus male), Spanish origin (non-Hispanic versus Hispanic), education level (without at least a bachelor's degree versus with at least a bachelor's degree versus with more than a bachelor's degree), and personal concussion history (*yes* versus *no*). The aORs related to child characteristics were computed for concussion history (*yes* versus *no*) and sport participation (*yes* versus *no*). Community-level characteristics were determined for the percentage of the community aged 25 and older with at least a bachelor's degree (discrete variable, with aORs examining the effects of 10% increases), the percentage of residents who were from racial or ethnic minoritized groups (discrete variable, with the aORs examining the effects of 10% increases), and the percentage of households below the poverty level (discrete variable, with the aORs examining the effects of 10% increases). The levels of increase in the discrete variables (ie, 10-year increase in

**Table 1. Participants' Individual and Community Characteristics (Totals and by Race and Ethnicity) and Differences Between Racial and Ethnic Groups**

Characteristic	By Race and Ethnicity, No. (%)		$\chi^2$ Test Comparing Race
	Black	White	
Social context factors			
Origin			.035 <sup>a</sup>
Hispanic	40 (15.7)	216 (21.7)	
Non-Hispanic	214 (84.3)	778 (78.3)	
Highest education level			<.001 <sup>a,b</sup>
<Bachelor's degree	171 (67.3)	508 (51.1)	
<High school	4 (1.6)	11 (1.1)	
High school graduate or GED	52 (20.5)	195 (19.6)	
Associate's degree	47 (18.5)	115 (11.6)	
Some college, no degree	68 (26.8)	187 (18.8)	
Bachelor's degree	49 (19.3)	301 (30.3)	
>Bachelor's degree	34 (13.4)	185 (18.6)	
Master's degree	25 (9.8)	109 (11.0)	
Professional degree	5 (2.0)	33 (3.3)	
Doctorate	4 (1.6)	43 (4.3)	
MS child's designation			<.001 <sup>a</sup>
Public	240 (94.5)	834 (83.9)	
Private	14 (5.5)	160 (16.1)	
Additional variables			
Sex			<.001 <sup>a</sup>
Female	182 (71.6)	600 (60.4)	
Male	72 (28.4)	394 (39.6)	
Personal concussion history			.451
No	180 (70.9)	680 (68.4)	
Yes	74 (29.1)	314 (31.6)	
MS child concussion history			.670
No	199 (78.3)	791 (79.6)	
Yes	55 (21.7)	203 (20.4)	
MS child played organized sports within the past year			.389
No	58 (22.8)	253 (25.4)	
Yes	196 (77.2)	741 (75.6)	
	By Race and Ethnicity, Median (IQR)		
Characteristic	Black	White	Wilcoxon Rank-Sum Test Comparing Race
Social context factors, %			
Residents aged 25+ y in zip code with more than a bachelor's degree	23.1 (16.5–35.3)	26.2 (17.7–38.2)	<.001 <sup>a</sup>
Residents in zip code from racial or ethnic minoritized groups	60.1 (34.2–85.7)	27.2 (12.8–52.0)	<.026 <sup>a</sup>
Households in zip code below poverty level	13.6 (7.7–22.3)	9.0 (5.2–14.9)	<.001 <sup>a</sup>
Additional variable			
Participant's age, y	35.0 (31.0–43.0)	39.0 (34.0–47.0)	<.001 <sup>a</sup>

Abbreviations: GED, graduate equivalency degree; IQR, interquartile range; MS, middle school.

<sup>a</sup>  $P < .001$ .

<sup>b</sup> Analysis comparing less than a bachelor's degree, bachelor's degree, and greater than a bachelor's degree.

age and 10% increase in community-level factors) were chosen a priori. All aORs with 95% CIs excluding 1.00 were deemed statistically significant.

## RESULTS

### Participants

Of the 1248 participants, most were non-Hispanic White (79.6%; Table 1). The median age for White parents was 39 years (interquartile range [IQR] = 34–47). Most were non-Hispanic (78.3%), had less than a bachelor's degree (51.1%), and were women (60.4%). The median age for Black parents was 35 years (IQR = 31–43). Most were non-Hispanic (84.3%), had less than a bachelor's degree (67.3%), and were women (71.6%). White and Black parents of MS

children differed regarding all social context factors (Table 1). White parents more frequently reported being Hispanic, having higher levels of educational attainment, having a MS child in private school, and living in communities with higher educational attainment with fewer racial or ethnic minoritized residents and with lower poverty levels than Black parents ( $P < .05$ ).

### Comparisons of Outcome Distributions by Race and Ethnicity

**Concussion Knowledge.** The proportion of parents who received previous concussion education differed by race and ethnicity (Table 2). Black parents more often described receiving previous concussion education than White parents (69.5% versus 60.5%,  $P = .009$ ). Regarding concussion symptom knowledge scores between White and Black parents,

**Table 2. Participants' Knowledge and Attitude Scores With Differences Between Races and Ethnicities Continued on Next Page**

Measure <sup>a</sup>	Categories	By Race and Ethnicity, No. (%)		$\chi^2$ Test Comparing Race
		White	Black	
<b>Primary Parental Outcomes</b>				
(K) Concussion education since 2017	No	385 (39.5)	76 (30.5)	.009 <sup>b</sup>
	Yes	590 (60.5)	173 (69.5)	
Measure <sup>a</sup>	Categories	By Race and Ethnicity, Median (IQR)		Wilcoxon Rank-Sum Test Comparing Race
		White	Black	
(K) Symptom knowledge scale score		40 (34–44)	37 (30–43)	.001 <sup>b</sup>
(A) Care-seeking attitudes scale score		32 (28–35)	32 (26–35)	.167
Measure <sup>a</sup>	Categories	By Race and Ethnicity, No. (%)		Mean Score Statistic Comparing Race
		White	Black	
(C) How much you talk with your children in middle school about concussions?	Never	179 (18.0)	41 (16.3)	.004 <sup>b</sup>
	Rarely (once or twice)	192 (19.3)	41 (16.3)	
	A few times	219 (22.1)	45 (17.9)	
	Sometimes	242 (24.4)	51 (20.3)	
	Always	161 (16.2)	73 (29.1)	
Measure <sup>a</sup>	Categories	By Race and Ethnicity, No. (%)		Mean Score Statistic Comparing Race
		White	Black	
<b>Secondary Parental Outcomes</b>				
(K) As long as symptoms resolve within 15 minutes, a middle school student who exhibits signs and symptoms consistent with concussion can be returned to sports on the same day.	Strongly disagree	388 (39.1)	102 (41.0)	.012 <sup>b</sup>
	Somewhat disagree	267 (26.9)	49 (19.7)	
	Somewhat agree	210 (21.1)	49 (19.7)	
	Strongly agree	128 (12.9)	49 (19.7)	
	(K) A middle school student exhibiting signs and symptoms consistent with concussion should complete a return to physical activity protocol before returning to physical activities (eg, PE).	Strongly disagree	77 (7.8)	
Somewhat disagree	92 (9.3)	31 (12.5)		
Somewhat agree	67 (26.9)	67 (26.9)		
Strongly agree	124 (49.8)	124 (49.8)		
(A) Currently, there is too much attention and focus on concussion in sports.	Strongly disagree	253 (25.5)	74 (29.5)	.547
Disagree	155 (15.6)	29 (11.6)		
Somewhat disagree	109 (11.0)	17 (6.8)		
Neither agree nor disagree	130 (13.1)	35 (13.9)		
Somewhat agree	87 (8.8)	24 (9.6)		
(A) If my child had a concussion, I would be worried about their long-term health.	Agree	119 (12.0)	30 (12.0)	.064
	Strongly agree	139 (14.0)	42 (16.7)	
	Strongly disagree	6 (0.6)	3 (1.2)	
	Disagree	16 (1.6)	3 (1.2)	
	Somewhat disagree	29 (2.9)	12 (4.9)	
(A) Middle school students don't know enough about concussions.	Neither agree nor disagree	107 (10.8)	24 (9.7)	.035 <sup>b</sup>
	Somewhat agree	211 (21.4)	33 (13.4)	
	Agree	291 (29.5)	56 (22.7)	
	Strongly agree	327 (33.1)	116 (47.0)	
	Strongly disagree	3 (0.3)	3 (1.2)	
(A) Middle school staff don't know enough about concussions.	Disagree	11 (1.1)	4 (1.6)	.482
	Somewhat disagree	21 (2.1)	8 (3.2)	
	Neither agree nor disagree	79 (8.0)	26 (10.3)	
	Somewhat agree	133 (13.4)	40 (15.8)	
	Agree	294 (29.6)	60 (23.7)	
(A) Middle school staff don't know enough about concussions.	Strongly agree	453 (45.6)	112 (44.3)	.482
	Strongly disagree	9 (0.9)	9 (3.6)	
	Disagree	32 (3.2)	6 (2.4)	
	Somewhat disagree	46 (4.6)	16 (6.4)	
	Neither agree nor disagree	161 (16.2)	42 (16.8)	
(A) Middle school staff don't know enough about concussions.	Somewhat agree	183 (18.4)	40 (16.0)	.482
	Agree	290 (29.2)	51 (20.4)	
	Strongly agree	272 (27.4)	86 (34.4)	

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**Table 2. Continued From Previous Page**

Measure <sup>a</sup>	Categories	By Race and Ethnicity, No. (%)		$\chi^2$ Test Comparing Race
		White	Black	
(A) Parents of middle school students don't know enough about concussions.	Strongly disagree	7 (0.7)	8 (3.2)	.021 <sup>b</sup>
	Disagree	20 (2.0)	5 (2.0)	
	Somewhat disagree	33 (3.3)	12 (4.8)	
	Neither agree nor disagree	102 (10.3)	35 (13.9)	
	Somewhat agree	180 (18.2)	43 (17.1)	
	Agree	309 (31.2)	60 (23.9)	
	Strongly agree	339 (34.2)	88 (35.1)	

Abbreviations: (A), attitude-related measure; (C), communication-related measure; IQR, interquartile range; (K), knowledge-related measure; PE, physical education.

<sup>a</sup> Items are reproduced in their original format.

<sup>b</sup>  $P < .05$ .

scores were higher for the former than the latter (40 versus 37,  $P < .001$ ). Among secondary concussion knowledge outcomes, the only measure with evidence of different distributions was related to same-day return to play. Agreement with same-day return to play if symptoms resolved within 15 minutes was higher among Black parents than White parents ( $P = .012$ ).

**Concussion Attitudes.** The distribution of responses by race and ethnicity for the care-seeking attitudes scale did not differ (Table 2). Among secondary attitude outcomes, 2 of the measures related to MS students and parents not knowing enough about concussions reflected different distributions ( $P = .035$  and  $P = .021$ , respectively). Black parents had less favorable attitudes than White parents with respect to MS children and MS parents knowing enough about concussions.

**Concussion Communication.** Differences were found in the distribution of concussion communication scores between White and Black parents (Table 2). Specifically, Black parents reported having more frequent communications about concussions with their MS children than White parents ( $P = .004$ ).

### Multivariable Models Stratified by Race and Ethnicity Examining Factors Associated With Outcomes

**Concussion Knowledge.** In the multivariable models conducted for White and Black parents separately, no associations were present between previous concussion education and social context factors in either race or ethnicity (Table 3). Regarding concussion symptom knowledge, White parents with more than a bachelor's degree had less favorable concussion symptom knowledge than those with less education (OR = 0.47; 95% CI = 0.30, 0.74). By contrast, findings from Black parents were not statistically significant (OR = 1.29; 95% CI = 0.52, 3.20).

**Concussion Attitudes.** In the multivariable models conducted for White and Black parents separately, the only significant association was between care-seeking attitudes and race and ethnicity. For White parents, the odds of better concussion care-seeking attitudes were lower in Hispanic parents than in non-Hispanic parents (OR = 0.50; 95% CI = 0.32, 0.79; Table 4). This result was not observed among Black parents (OR = 0.79; 95% CI = 0.30, 2.04).

**Concussion Communication.** In the multivariable models conducted for White and Black parents separately, no associations were evident between communication with MS children about concussions and the social context factors in either race or ethnicity (Table 4).

### DISCUSSION

In this study, the multivariable models showed that the associations between concussion knowledge, attitudes, and communication and social context factors, including Hispanic origin, educational attainment, the MS child's school designation, and community-level factors, mostly did not differ based on MS parents' race and ethnicity. The univariate models indicated that, even though more Black parents reported receiving previous concussion education than White parents, Black parents did not have greater concussion symptom knowledge or more favorable attitudes. However, Black parents did more often communicate about concussions with their MS children than White parents. Although the primary attitude measures were mostly similar between Black and White parents, several notable differences in the secondary attitude measures could be addressed through the development and implementation of future concussion education programs in more diverse populations.

To our knowledge, this is the first analysis of its kind examining parental outcomes pertaining to concussion. We hypothesized that being socially disadvantaged would increase the frequency of reporting less favorable outcomes in Black parents of MS-aged children compared with White parents. Although our findings trended in the direction of our hypothesis, we did not observe that race and ethnicity was an effect measure modifier for the association between social context factors and outcomes pertaining to concussion in parents of MS-aged children. Our results were similar to those seen in related studies of the effects of race and ethnicity and SES on concussion nondisclosure in collegiate athletes.<sup>18</sup> Wallace et al<sup>18</sup> determined that race and ethnicity were not effect measure modifiers for concussion nondisclosure, and there were no associations with SES. It is important to note that these results also trended toward our hypothesis, but the authors acknowledged that their analyses were likely underpowered. As such, more research comparing concussion outcomes in greater numbers of Black and White participants is needed to truly understand the relationships of these factors with SES.

Because our analyses and those of previous studies<sup>18</sup> were underpowered and the results trended toward differences by race and ethnicity, investigators should continue to examine how these disparities can be addressed. Evidence from other disciplines has indicated that to reduce disparities in SDOH, interventions should target multiple levels of the socioecological model.<sup>19</sup> In fact, Brown et al<sup>20</sup> argued that

**Table 3. Adjusted Odds Ratios (ORs) for Primary Measures of Concussion Knowledge by Individual Characteristics and Race and Ethnicity**

Variable	Adjusted OR (95% CI)			
	Concussion Education Received (Odds of Answering Yes)		Concussion Symptom Knowledge (Odds of Higher Level)	
	White	Black	White	Black
<b>Origin</b>				
Non-Hispanic	1.0	1.0	1.0	1.0
Hispanic	1.08 (0.73, 1.59)	1.42 (0.49, 4.10)	0.73 (0.48, 1.10)	0.46 (0.20, 1.03)
<b>Highest education level</b>				
<Bachelor's degree	1.0	1.0	1.0	1.0
Bachelor's degree	1.10 (0.78, 1.54)	0.65 (0.27, 1.58)	1.12 (0.74, 1.71)	1.20 (0.54, 2.65)
>Bachelor's degree	1.53 (0.98, 2.39)	0.59 (0.22, 1.60)	0.47 (0.30, 0.74) <sup>a</sup>	1.29 (0.52, 3.20)
<b>MS child's designation</b>				
Public	1.0	1.0	1.0	1.0
Private	0.89 (0.57, 1.37)	1.40 (0.27, 7.00)	0.71 (0.45, 1.10)	0.58 (0.18, 1.93)
<b>Community-level factors, %</b>				
Residents in the participants' communities aged ≥25 y with at least a bachelor's degree (10% increase)	0.95 (0.85, 1.07)	1.03 (0.78, 1.37)	1.00 (0.89, 1.13)	1.07 (0.83, 1.37)
Residents from the participants' communities who are from racial and ethnic minoritized groups (10% increase)	0.98 (0.92, 1.05)	0.94 (0.81, 1.09)	0.92 (0.85, 1.00)	1.03 (0.91, 1.17)
Households from the participants' communities below poverty level (10% increase)	0.88 (0.68, 1.14)	0.94 (0.58, 1.50)	0.88 (0.66, 1.17)	0.99 (0.63, 1.55)
<b>Additional variables</b>				
Age (10-y increase)	0.92 (0.79, 1.07)	0.81 (0.57, 1.16)	1.50 (1.24, 1.82) <sup>a</sup>	1.28 (0.92, 1.80)
<b>Sex</b>				
Male	1.0	1.0	1.0	1.0
Female	0.95 (0.70, 1.30)	1.31 (0.63, 2.72)	1.95 (1.37, 2.77) <sup>a</sup>	2.45 (1.31, 4.57) <sup>a</sup>
<b>Personal concussion history</b>				
No	1.0	1.0	1.0	1.0
Yes	2.11 (1.52, 2.93) <sup>a</sup>	2.40 (1.04, 5.53) <sup>a</sup>	1.80 (1.22, 2.65) <sup>a</sup>	1.36 (0.68, 2.73)
<b>MS child concussion history</b>				
No	1.0	1.0	1.0	1.0
Yes	2.30 (1.49, 3.54) <sup>a</sup>	6.44 (1.74, 28.85) <sup>a</sup>	0.52 (0.34, 0.80) <sup>a</sup>	0.38 (0.18, 0.79) <sup>a</sup>
<b>MS child playing sports</b>				
No	1.0	1.0	1.0	1.0
Yes	4.12 (2.98, 5.70) <sup>a</sup>	7.77 (3.73, 16.16) <sup>a</sup>	1.76 (1.20, 2.59) <sup>a</sup>	1.71 (0.82, 3.54)

Abbreviation: MS, middle school.

<sup>a</sup> Significant at  $P < .05$ .

structural interventions targeting systemic factors that influence health measures at the outer levels of the socioecological model are needed to address these disparities. It may also be appropriate to address barriers to successful outcomes in concussion education, such as inadequate literacy and health literacy.<sup>21,22</sup>

More frequent self-reporting of previous concussion education was not associated with better concussion symptom knowledge, attitudes, or communication in Black parents of MS-aged children compared with White parents. Patel and Trowbridge<sup>23</sup> noted that parents of youth athletes lacked an understanding of concussion and had low self-efficacy regarding their concussion knowledge and education and their ability to identify concussion symptoms despite exposure to concussion education. As such, differences in self-efficacy may account for the differences seen here, but more research is needed to understand the disparity. Wallace et al<sup>24</sup> found that White parents of high school athletes had better concussion knowledge than their Black counterparts. Similarly, Haarbauer-Krupa et al<sup>25</sup> showed that White/non-Hispanic parents of children in elementary school had better concussion knowledge than other racial/ethnic groups, suggesting that concussion education for parents can be made more effective. Best practices that can reduce disparities in new or existing educational programs

include ensuring that the programs are culturally responsive, skills based, and interactive (as opposed to didactic).<sup>26</sup> Similar to reducing SDOH disparities, it may be necessary to address multiple levels of the socioecological model.<sup>19</sup> At the outer levels of the socioecological model, it is important to have authentic engagement with community leaders, stakeholders, and partners in the planning and execution of programs to enhance implementation and reduce disparities.<sup>19</sup>

Black parents more often agreed with same-day return to play after symptoms resolved (worse outcome) than White parents. Additionally, Black parents had less favorable attitudes than White parents regarding MS-aged children and parents of MS-aged children knowing enough about concussion. These findings, combined with those from our multivariable analysis, that Black parents more commonly reported talking with their MS children about concussion (better outcome) than White parents, are particularly interesting. Despite having worse knowledge of some items and feeling that they did not know enough about concussion, Black parents were communicating with their MS children about concussions more than White parents. It is possible that, because Black parents felt their MS children did not have sufficient concussion knowledge, they increased communication relative to White parents to address that gap. In aggregate, these results

**Table 4. Adjusted Odds Ratios (ORs) for Primary Parent Outcome for Concussion Attitudes and Communication by Individual Characteristic and Race and Ethnicity**

Variable	Adjusted OR (95% CI)			
	Concussion Care-Seeking Attitudes (Odds of More Positive Attitude)		Talking With MS Children About Concussion (Odds of Higher Frequency)	
	White	Black	White	Black
Origin				
Non-Hispanic	1.0	1.0	1.0	1.0
Hispanic	0.50 (0.32, 0.79) <sup>a</sup>	0.79 (0.30, 2.04)	1.11 (0.81, 1.55)	1.57 (0.74, 3.32)
Highest education level				
<Bachelor's degree	1.0	1.0	1.0	1.0
Bachelor's degree	1.42 (0.88, 2.23)	2.24 (0.80, 6.25)	1.23 (0.91, 1.66)	0.83 (0.43, 1.60)
>Bachelor's degree	1.14 (0.65, 1.98)	0.63 (0.25, 1.57)	1.89 (1.30, 2.74)	0.79 (0.38, 1.64)
MS child's designation				
Public	1.0	1.0	1.0	1.0
Private	1.33 (0.74, 2.39)	0.76 (0.20, 2.90)	1.49 (1.04, 2.14)	1.34 (0.46, 3.86)
Community-level factors, %				
Residents from the participants' communities aged ≥25 y with at least a bachelor's degree (10% increase)	1.06 (0.92, 1.23)	1.05 (0.79, 1.39)	0.98 (0.90, 1.08)	1.02 (0.83, 1.25)
Residents from the participants' communities who are from racial and ethnic minoritized groups (10% increase)	0.99 (0.90, 1.08)	0.98 (0.85, 1.14)	0.99 (0.93, 1.05)	1.05 (0.94, 1.17)
Households from the participants' communities below poverty level (10% increase)				
Additional variables	1.34 (0.93, 1.94)	1.11 (0.67, 1.84)	1.23 (0.98, 1.54)	1.00 (0.69, 1.44)
Age (10-y increase)	1.22 (1.00, 1.49)	1.31 (0.89, 1.94)	0.94 (0.82, 1.08)	1.25 (0.95, 1.64)
Sex				
Male	1.0	1.0	1.0	1.0
Female	1.29 (0.87, 1.92)	2.21 (1.09, 4.46) <sup>a</sup>	1.04 (0.80, 1.36)	1.36 (0.79, 2.33)
Personal concussion history				
No	1.0	1.0	1.0	1.0
Yes	1.43 (0.93, 2.18)	1.40 (0.63, 3.11)	1.48 (1.13, 1.95)	0.85 (0.44, 1.65)
MS child concussion history				
No	1.0	1.0	1.0	1.0
Yes	0.57 (0.35, 0.94) <sup>a</sup>	0.54 (0.24, 1.25)	2.35 (1.68, 3.28)	1.50 (0.77, 2.90)
MS child playing sports				
No	1.0	1.0	1.0	1.0
Yes	2.12 (1.41, 3.18) <sup>a</sup>	1.62 (0.72, 3.82)	2.92 (2.16, 3.95) <sup>a</sup>	3.55 (1.91, 6.61)

Abbreviation: MS, middle school.

<sup>a</sup> Significant at  $P < .05$ .

are particularly important because they demonstrate possible problems in the reach or interpretation of existing concussion initiatives aimed at Black parents of MS children. This may be due, in part, to a disconnect between those who create educational interventions and the intended audience through bias. Evidence used to create interventions may be biased in favor of White participants due to the racial and ethnic composition of populations studied.<sup>27</sup> Future authors should aim to reach more diverse populations. Within individuals who develop interventions, additional biases may be present that can perpetuate racial and ethnic health disparities.<sup>28</sup>

Finally, the attitudes were mostly similar between Black and White parents of MS-aged children. For both Black and White parents, those who were Hispanic had less favorable care-seeking attitudes than those who were non-Hispanic, although this relationship was not significant among Black parents. Hispanic parents also tended toward having less concussion symptom knowledge; however, this relationship was also not significant. The items in the survey may not have been sensitive enough to detect differences in attitudes

between these groups. We were unable to detect differences between Hispanic and non-Hispanic parents by race and ethnicity, likely due to underpowering of the analyses. The less favorable outcomes may have been partially due to language barriers. This possibility was supported by Cusimano et al,<sup>9</sup> who found that language was a good predictor of concussion knowledge in communities consisting of athletes, parents, and coaches. To reduce disparities among ethnic groups, it is appropriate to implement bilingual educational programs.<sup>29</sup>

Our outcomes indicate that more work is needed to understand how to enhance the delivery of concussion education to Black and Hispanic parents of MS-aged children. Kroshus et al<sup>30</sup> observed that it is important to consider equity and effectiveness in the implementation of concussion education to address disparities. Educational resources should be accessible to all in an equitable manner that eliminates barriers. Although their concept was not fully supported by our results, Cusimano et al<sup>9</sup> recommended aiming the design and implementation of concussion education programs at those with less education or non-English-speaking people without a



history of or experience with concussion (or both). Other authors have reiterated the need to provide actionable steps that parents can take to confront the threat of concussion in their children.<sup>31,32</sup>

## Limitations

We note several limitations of our work. As previously mentioned, some of our analyses were underpowered and thus were not able to detect differences if they existed. This was a secondary data analysis. Therefore, questions were not included that would have specifically targeted important social context factors, such as parental income or employment type, health insurance status, or access to sports medicine professionals in schools. Additionally, no questions asked parents to expand on or detail their previous concussion education. Although the sample was nationally representative, the participant pool may not have been representative of all parents of MS-aged children, which limits the generalizability of the findings. All parents of MS-aged children were surveyed, not just those whose MS children played sports. Parents of MS children who did not play sports were unlikely to have received concussion education. Finally, the analyses were not separated by child; instead, they were performed on the parents of MS children, regardless of the number of MS children they had. This limitation affects the proportion of MS children captured in the data, which, again, may restrict the generalizability of the findings.

## Implications for Practice

Practitioners can consider performing a community needs assessment before implementing concussion education programs. Doing so can help contextualize health disparities in the community, evaluate contributing SDOH and level of health literacy, enhance cultural responsiveness in the delivery of concussion education programs, and lay the groundwork to address identified health disparities.<sup>33</sup> Practitioners can modify existing concussion education programs to better suit the needs of the community at multiple levels of the socioecological model. Factors to consider when deciding how to revise existing or create new concussion education programs to reduce disparities include the languages spoken in the community, the levels of literacy and health literacy in the community, the cultural responsiveness of the program, enhancing self-efficacy, the implementation of skill-based interactivity, and authentic engagement with community leaders and stakeholders.

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Address correspondence to Alicia M. Montalvo, PhD, MPH, LAT, ATC, 550 North 3rd Street, Phoenix, AZ 85004. Address email to [alicia.montalvo@asu.edu](mailto:alicia.montalvo@asu.edu).