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Parent–Child communication about concussion: what role can the Centers for Disease Control and Prevention's HEADS UP concussion in youth sports handouts play?

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Abstract

Background: Concussion education for parents/guardians (hereafter referred to as parents) has the potential to play an important role in youth athlete concussion safety. The goal of this study was to evaluate the impact of the Centers for Disease Control and Prevention's (CDC) HEADS UP handout on parent–child communication about concussion.

Methods: YMCA branches from 15 associations from across the United States were randomized to CDC HEADS UP intervention condition or education as usual control condition using a cluster randomization strategy. In the intervention condition, coaches shared parent- and athlete-specific handouts with parents and asked parents to share and discuss the athlete-specific handouts with their child. Generalized estimating equations, with repeated measures to account for the correlation among matched participants and YMCA associations, were employed.

Results: Multivariable analyses exploring the relationship between time (pre- and post-intervention) and communication showed that the percent of parents who talked to their child about concussion increased in the intervention group (aRR=1.33, 95% CI=1.22, 1.44), but not in the control group.

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Conclusion: CDC HEADS UP handouts help families talk about concussion safety. Sports organizations seeking to educate parents of athletes about concussion should consider using CDC HEADS UP handouts and following a similar dissemination strategy.

Keywords

Concussion; parent; athlete; reporting; communication; education

Introduction

Concussions are a common youth sport injury, and early removal from play for medical evaluation is critical for harm reduction. Concussion symptoms are not always visible to an external observer (1). Consequently, removal from play often relies on athletes speaking up to a trusted adult. Data across many sports, ages, and levels of competition, indicate that as many as half of athletes who experience potential concussive symptoms try to keep playing post-injury (2). This is problematic for several reasons. First, early care seeking post-injury is associated with a faster return to symptom-free activity (3,4). Second, during the symptomatic period post-injury the brain is in a state of metabolic vulnerability where there is the potential for magnified neurologic consequences if another injury is sustained (5). Third, there is elevated risk of musculoskeletal injury with continued play during this time period (6). Finally, continued play and delayed care seeking means that athletes who are in fact experiencing a more serious brain injury might not receive necessary emergency medical attention.

Parents/guardians (hereafter referred to as parents) have the potential to influence their child-athlete's care seeking behavior if they sustain a suspected concussion through the pressure athletes experience related to continued play with concussive symptoms (7). Athlete experiences of parental pressure are in part explained by a lack of direct verbal communication from parents about the importance of concussion safety (8–10). Recent consensus indicates that there are two key topics to discuss when talking to one's child about concussion safety: reporting signs and symptoms of a suspected concussion and sport-specific concussion safety practices (11). A national survey of parents of youth soccer players found that most believed talking to their child about concussion was important, and planned to talk to their child about concussion safety (12). However, other research found variability in whether such communication occurred in practice (8,9). Among parents of youth soccer players, concussion safety communication is more likely when their child has previously had a concussion, when they perceive that their child is at elevated risk of sustaining a future concussion, or when they place lower value on their child's sport achievement (8).

The Centers for Disease Control and Prevention's (CDC) HEADS UP educational handouts for parents have the potential to support safety-oriented within-family communication (11,13) and are disseminated to millions of sports-playing families in the United States each year (13). The most commonly used CDC HEADS UP parent handout is the "Concussion Information Sheet," which contains information about concussion signs and symptoms, and suggestions for parents about how they can keep their child safe. These suggestions include

emphasizing the importance of reporting concussions and taking time to recover, as well as the importance of following guidance from their coach about sport-specific safety practices (13). Evaluations of these materials to-date have assessed changes in knowledge about concussion, but not change in parent–child communication about concussion safety (14,15). Addressing this gap, the goal of the present study was to evaluate the effectiveness of the CDC HEADS UP handouts on parent–child communication about concussion safety.

Methods

Sample and procedure

Eligibility and randomization—Fifteen YMCA associations were recruited from across the West, Midwest, and South of the United States. A cluster randomized strategy was used whereby within each association, each eligible and participating branch (i.e., location) was randomly assigned to either the intervention or control group. Branch schedules were examined to make certain that treatment and control branches did not play each other. This frequently led to branches being grouped (with varying group sizes) and the groups randomized. At participating branches, eligible teams were volleyball, basketball, soccer, football, or baseball, with youth athletes ages 12 and older. On some teams, younger (10 and 11 year old) athletes were also members; parents of these individuals were also eligible to participate in the study.

Survey development—Survey questions were based on existing published measures (16–18) where possible, with modifications made to reflect the population of interest (parents) and target behaviors (communication with child). Cognitive interviewing was conducted with parents of athletes at one YMCA until thematic saturation, with adjustments to item wording to ensure clarity.

Data collection—Surveys were administered at two time-points. YMCA staff directly sent e-mails to parents asking them to complete surveys at the link provided. Coaches were also sent text to distribute to parents via e-mail to ask them to complete surveys. This means of survey distribution was supplemented by paper surveys (distributed by study staff) at two sites with particularly low response rates. The first survey was completed prior to or at the start of the competitive season and before CDC HEADS UP handouts were distributed. Parents completed the second survey toward the end of the season, between 6 and 8 weeks after the first survey. Prior to starting the survey, participants read and were asked to sign (paper) or agree with a displayed consent form (online). Parents were told that “To thank you and the other parents for taking the surveys, we have given your Y some funds for an end-of-season celebration.” Participants were asked to provide their first name, the day of the month on which they were born as well as the house number from their street address. These data, together with association and branch information, were used to match surveys while keeping the identity of the survey takers confidential. Study activities were approved by the FHI 360 Institutional Review Board, and survey data were collected as part of a larger evaluation of CDC HEADS UP materials in youth-serving organizations. Intervention activities and data collection occurred between November 2016 and October 2018.

Intervention implementation—Branches assigned to the intervention condition distributed CDC HEADS UP handouts to parents at the start of the competitive season, after data collection for the first survey data closed. Distribution occurred in the following manner: branch administrators provided the parent and athlete handouts to coaches of eligible teams, instructing coaches to share these handouts with parents. Branches assigned to the control condition did not receive any new educational materials (e.g., considered education as usual). No control organization reported disseminating CDC HEADS UP handouts, or any other formal concussion education materials, during the intervention period.

Measures

The primary outcome was a constructed variable that combined parents' responses to two questions, "Have you ever talked to your child about how to prevent a concussion?" (Yes/No) and "Have you ever talked to your child about what to do if they think they have a concussion?" (Yes/No). If a parent said 'Yes' to either of these questions, they were classified as ever having talked to their child about concussion. A secondary outcome was parent intentions to talk to their child about concussion safety in the future, using an analogous two-item measure with response options on a 4-point Likert scale, ranging from very unlikely to very likely. Parents responding "very likely" to either item were assigned a score of 1, and others a score of 0. Additional covariates measured were parent demographic characteristics (sex, race/ethnicity, highest level of education completed), level of contact in their child's sport (contact/collision = basketball, soccer, or football, limited contact = baseball, softball, or volleyball), parent or child history of concussion diagnosis. Parents also indicated the types of concussion information they had been exposed to separate from the intervention, which included: online training; poster; fact sheet; quiz; website information; an app; movie or documentary; TV show; presentation or talk; book, magazine or other print material; and social media.

Analysis

Analyses were conducted separately for the intervention and the control groups. Bivariate and multiple regression analyses to determine if the proportion of parents who ever talked to their child about concussion improved from pre- to post-season, and to identify factors associated with parent–child communication. In the first step of model selection, a bivariate model was applied which included only a single variable at a time to assess associations with the outcome variable assessing whether parents ever talked to their child about concussion. Since more traditional levels such as 0.05 can fail in identifying variables known to be important, we chose a *P*–value cutoff point of 0.20 as a first step (19,20). All candidate variables that had *P*–values ≤0.20 in the bivariate models were entered into the multivariable model selection. We used stepwise selection in developing a final multivariable model without relying on entry and stay significance levels, which may overfit data and yield a model with poor predictive performance. The cross validation (CV) predicted residual error sum of squares (PRESS) statistic assesses the predictive performance of the model and was used as the selection criterion to choose among models (21). Among these models, the one yielding the smallest value of the CV PRESS statistic was selected and the process was repeated until no additions or deletions reduced the CV PRESS statistic value.

The analytic intent was to measure within-person changes in survey responses across the two time points. However, due to the low number of parents who completed both the pre- and post-surveys, we used a cross-sectional analysis approach with generalized estimating equations [GEE] repeated measures to account for the correlation among matched participants and a potential cluster effect for YMCA associations. A robust Poisson model with sandwich standard error estimator generated by GEE was used to estimate the risk ratios (RR) in the bivariate models and adjusted risk ratios (aRR) in the multivariable models (22). Similarly, an additional analysis was conducted at the individual level with the smaller subset of parents who had full data.

Results

There were a total of 2096 observations (pre- = 1337, post-intervention = 759) from our survey collected from 75 branches within 15 YMCA associations (Supplementary Figure 1). From the total observations, 510 were removed because there was no valid answer for the question on ever talked to your child about concussion. Our analysis used observations from 1,062 (intervention = 755, control = 307) surveys pre- and 524 (intervention = 368, control = 156) post-intervention. Most parents participated in only one round of the two rounds of data collected (pre- = 968, post-intervention = 430). There were 94 parents (intervention = 79, control = 15) who took both the pre- and post-intervention surveys. An estimated 9464 parents were eligible to participate in the study (1183 teams, and an estimated eight athletes per team, with one parent eligible per athlete), for an estimated 15% response rate.

Demographic characteristics were similar across time periods, regardless of cohort. Most of the parents who participated were female, had an undergraduate or graduate degree, and were predominantly white (Table 1). Sports play was similar across groups except for pre-intervention controls who had a smaller percentage of children participating on contact sports teams. The percentage of parents who had ever been told by a medical professional that they had had a concussion was under 15% in each group, as was the percentage of parents who had ever been told by a medical professional that their child had had a concussion (< 15% in each group). Eighty percent or more of respondents in each group reported that they had previously been exposed to some concussion information that was not related to this intervention.

In bivariable analysis, after the intervention, the number of parents who talked to their child about concussion increased 28% (RR = 1.28, 95%CI = 1.18,1.40) in the intervention group, but there was no change in the control group (RR = 1.05, 95%CI = 0.88, 1.24) (Table 2). Whether a child had a concussion, exposure to nonintervention concussion materials, and intention to talk with one’s child about concussion were strongly associated with ever having talked with one’s child about concussion, in both the intervention and control group ($p < 0.0001$). In the control group, ever having talked to one’s child about concussion was significantly associated with parent level of education ($p = 0.0023$) and whether the child was playing basketball/soccer/football ($p = 0.0151$).

Through our multivariable analysis we found that after the intervention the percentage of parents who talked to their child about concussion increased 33% (aRR = 1.33, 95%CI

= 1.22,1.44) in the intervention group, but there was no change in the control group (aRR = 0.99, 95%CI = 0.84, 1.16) (Table 3). In both the intervention and control groups, child history of diagnosed concussion, nonintervention exposure to concussion information materials, and an intention to talk to their child about concussion were strongly associated ($p < 0.0001$) with ever having talked to their child about concussion. Ever having talked to their child about concussion was marginally inversely associated with parent level of educational attainment ($p = 0.0290$) in intervention group and with played basketball/soccer/football ($p = 0.0487$) in the control group.

Results of a sub-analysis of the 94 parents who had complete data were consistent with the above multivariable analyses. At post-season, the percentage of parents who had ever talked to their child about concussion increased significantly in the intervention group (aRR = 1.38 95% CI = 1.19,1.60, $p < 0.0001$), but not in the control group (aRR = 1.07, 95% CI = 0.84,1.36, $p = 0.591$) (Supplementary Table 1).

Discussion

Parent–child communication about concussion safety is a key strategy to increase a child's likelihood of engaging in risk-reducing behaviors (11), and encouraging these behaviors is an explicit target of CDC HEADS UP handouts for parents (13). The present study suggests that when youth sport coaches disseminate the CDC HEADS UP handout to parents and encourage them to share these materials with their child, there is increased parent–child communication about concussion safety. Many organizations are already using the CDC HEADS UP for parents, and the present results suggest that when disseminated in this manner they are effective in increasing parent-child communication.

We note that independent of exposure to the HEADS UP materials, parents with more years of formal education, and parents with more self-reported exposure to other source of concussion information, had an elevated likelihood of talking to their child about concussion safety. Thus, CDC HEADS UP materials need to be viewed as one component of parents' informational ecosystem. Sports organizations and individuals involved in developing concussion education should ensure they are meeting the learning needs of all parents, including those who have fewer years of formal education, and less access to concussion information, whether through their social networks, or through their own information seeking. As part of the development process, CDC HEADS UP materials undergo formative testing (e.g., focus groups) with the target audience and are evaluated to ensure they meet the criteria outlined in the Plain Language Act of 2010 (23) and the CDC Clear Communication Index (24) – a research-based tool designed to assess communication products for clarity and understand-ability of scientific content and messages. Revisiting this process on a regular basis may help ensure materials are meeting the evolving informational needs of all youth sport parents.

Consensus guidelines for concussion education that emphasize the importance of not only providing individuals with appropriate information but also attending to the process through which this content is disseminated and implemented, given the important role interpersonal interactions can play in message acceptance and retention (25). In the present study, sports

administrators at participating YMCA branches shared CDC HEADS UP handouts with coaches, who then handed out parent- and child-focused handouts to parents and asked them to share and discuss the athlete-focused handouts with their child. This approach uses the concussion education process as an opportunity to foster important between-group dialog (26). Providing parents with a handout to share with their child may make the task of communicating about concussion safety more concrete and facilitate an easier entry point to conversation. The physical handout may also provide a cue or reminder about the need to have this conversation. Further research is needed to explore the education dissemination and implementation process in more detail, including comparing the impact of CDC HEADS UP handouts under different dissemination conditions, and determining whether additional support or guidance could feasibly be provided to enhance within-family communication. One emergent consideration may be the climate footprint of educational materials. While the present study focused on paper handouts for parents, CDC HEADS UP resources are also available in web-based formats. Encouragement may be provided to sports organizations to disseminate of these versions of the resources.

A key limitation of the present study is the low rate of parent participation across both surveys, necessitating a comparison of unmatched samples within intervention and control groups as our primary analytic approach. Sub-analyses examining the parents who provided matched pre- and post-intervention data supported the between-condition differences observed in the primary analyses. It is possible that parents responding to the survey at any time point were more interested or invested in concussion safety than non-responding parents, limiting the generalizability of the results to all parents of YMCA-based sports participants. These limitations to generalizability within the sample are in part the consequence of an explicit programmatic decision to understand the effectiveness of CDC HEADS UP handouts when disseminated across a range of sports, organizational units, and geographical areas. Such an approach was grounded in recognition that organizational and coaching differences could substantially influence whether handouts reached parents, and the messaging accompanying their dissemination – ultimately impacting their effectiveness. However, this approach introduced logistical barriers to a providing a high degree of technical support each site and meant that site contact and surveys were primarily electronic.

We also note that the YMCA environment may not be like other youth-serving sports organizations, and this may impact the types of families enrolled and the type of formal and informal coach and administrative messaging to parents about the relative value of concussion safety. Additionally, participating parents were largely female, white, and highly educated, and their responses to CDC HEADS UP handouts is unlikely to be generalizable more broadly to all parents. Extension of the present study to other settings and groups of parents is needed, and potentially to parent–child communication about head injuries that occur outside of the sport context. Further, extension of this work to parents of younger athletes (e.g., under age 10) is needed. Finally, this study only assessed change in one target behavior: parent–child communication about concussion safety. Future research is needed to determine whether CDC HEADS UP handouts for parents influence other outcomes. Finally, we note that this study describes the effectiveness of a “low dose” intervention, where the CDC HEADS UP handouts shared with parents and the expectations on parents were intended to be feasible and to approximate what is sustainable in programs that

have minimal resources available to support implementation. More intensive and formalized approaches to implementation may result in larger effect sizes and should be tested in subsequent studies.

Conclusion

The CDC HEADS UP handouts help parents and their athletes have an important conversation about concussion safety. Sports organizations seeking to use CDC HEADS UP handouts for concussion education should attend to how they are shared with parents and consider following a similar dissemination strategy as was used in the present study, in which parents receive handouts for themselves and their child and are encouraged to share and discuss the handouts with their child.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Disclaimer

The findings and conclusions in this manuscript are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Table 1.

Characteristics of parents and their children who participated in a pre/post-intervention survey of the centers for disease control and prevention HEADS UP handouts by intervention and control groups*.

	Pre intervention (N = 1062)				Post intervention (N = 524)			
	Intervention (n = 755)		Control (n = 307)		Intervention (n = 368)		Control (n = 156)	
Variables	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Sex								
Male	221	29.3	89	29.0	101	27.4	51	32.7
Female	531	70.3	211	68.7	259	70.4	100	64.1
Missing	3	0.4	7	2.3	8	2.2	5	3.2
Race/Ethnicity								
White non-Hispanic	544	72.1	206	67.1	272	73.9	113	72.4
Black non-Hispanic	62	8.2	36	11.7	25	6.8	10	6.4
Hispanic	94	12.5	34	11.1	41	11.1	14	9.0
Other non-Hispanic **	40	5.3	22	7.2	19	5.2	11	7.1
Missing	15	2.0	9	2.9	11	3.0	8	5.1
Education								
≤ high school	53	7.0	29	9.4	31	8.4	14	9.0
Some college or associate degree	177	23.4	84	27.4	76	20.7	32	20.5
Undergraduate degree	269	35.6	90	29.3	123	33.4	62	39.7
Graduate degree	254	33.6	96	31.3	131	35.6	44	28.2
Missing	2	0.3	8	2.6	7	1.9	4	2.6
Played Basketball, Soccer, football								
Yes	625	82.8	220	71.7	320	87.0	134	85.9
No	92	12.2	51	16.6	42	11.4	18	11.5
Missing	38	5.0	36	11.7	6	1.6	4	2.6
Played baseball, softball, volleyball								
Yes	655	86.8	265	86.3	328	89.1	143	91.7
No	98	13.0	40	13.0	40	10.9	12	7.7
Missing	2	0.3	2	0.7	0	0.0	1	0.6
Has a doctor or other medical professional ever told you that you have a concussion?								
Yes	98	13.0	40	13.0	40	10.9	12	7.7
No	655	86.8	265	86.3	328	89.1	143	91.7
Missing	2	0.3	2	0.7			1	0.6
Has a doctor or other medical professional ever told you that your child had a concussion?								
Yes	96	12.7	26	8.5	43	11.7	8	5.1
No	658	87.2	281	91.5	321	87.2	147	94.2
Missing	1	0.1	0	0.0	4	1.1	1	0.6
Any types of concussion Information Exposure before intervention								

	Pre intervention (N = 1062)				Post intervention (N = 524)			
	Intervention (n = 755)		Control (n = 307)		Intervention (n = 368)		Control (n = 156)	
Variables	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Yes	679	89.9	253	82.4	333	90.5	134	85.9
No	76	10.1	54	17.6	35	9.5	21	13.5
Missing							1	0.6
Intention to talk to child about concussion								
Yes	565	74.8	220	71.7	255	69.3	113	72.4
No	168	22.3	72	23.5	87	23.6	32	20.5
Missing	22	2.9	15	4.9	26	7.1	11	7.1
Ever talked to your child about concussion								
Yes	417	55.2	161	52.4	259	70.4	87	55.8
No	338	44.8	146	47.6	109	29.6	69	44.2

*Excluded those missing the outcome – Ever talked to your child about concussion. Out of 1586 survey responses, there were 1492 unique participants; 94 took part in both pre and post survey data collection.

**Non-Hispanic with race of American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander

Table 2.

Factors associated with parents who ever talked their child about concussion in pre-/post-intervention survey of the centers for disease control and prevention HEADS UP materials by intervention and control groups *.

	Intervention						Control					
	Ever talked to your child about concussion						Ever talked to your child about concussion					
	Yes		No				Yes		No			
Variables	**#**	**%**	**#**	**%**	**RR (95% CI)**	**P**	**#**	**%**	**#**	**%**	**RR (95% CI)**	**P**
Pre/post intervention												
1(Baseline)	417	61.7	338	75.6	Ref	**<0.0001**	161	64.9	146	67.9	Ref	0.5847
2(Post intervention)	259	38.3	109	24.4	1.28 (1.18, 1.4)		87	35.1	69	32.1	1.05 (0.88, 1.24)	
Sex												
Male	186	27.8	136	30.8	Ref	0.3490	70	28.8	70	33.7	Ref	0.2958
Female	484	72.2	306	69.2	1.05 (0.94, 1.18)		173	71.2	138	66.3	1.11 (0.91, 1.35)	
Race/Ethnicity												
Hispanic	77	11.6	58	13.4	Ref		24	10.1	24	11.5	Ref	
White non-Hispanic	500	75.4	316	72.8	1.12 (0.95, 1.31)	0.5527	181	76.1	138	66.3	1.19 (0.87, 1.62)	**0.1657**
Black non-Hispanic	49	7.4	38	8.8	1.07 (0.85, 1.35)		19	8.0	27	13.0	1.02 (0.64, 1.63)	
Other non-Hispanic **	37	5.6	22	5.1	1.11 (0.87, 1.40)		14	5.9	19	9.1	0.77 (0.43, 1.37)	
Education												
Some college or associates degree, High school, less than high school	213	31.7	124	28.0	Ref	0.3062	67	27.7	92	44.0	Ref	**0.0023**
Undergraduate degree	226	33.7	166	37.5	0.91 (0.80, 1.03)		93	38.4	59	28.2	1.44 (1.15, 1.80)	
Graduate degree	232	34.6	153	34.5	0.96 (0.85, 1.07)		82	33.9	58	27.8	1.38 (1.10, 1.74)	
Played Basketball, Soccer, football												
Yes	570	87.4	375	87.8	0.98 (0.85, 1.14)	0.8298	201	87.8	153	78.9	1.4 (1.04, 1.89)	**0.0151**
No	82	12.6	52	12.2	Ref		28	12.2	41	21.1	Ref	
Played baseball, softball, volleyball												
Yes	128	19.6	76	17.8	1.05 (0.93, 1.18)	0.4656	36	15.9	44	22.9	0.79 (0.62, 1.02)	0.0552
No	525	80.4	351	82.2	Ref		190	84.1	148	77.1	Ref	
Has a doctor or other medical professional ever told you that you had a concussion?												

	Intervention						Control					
	Ever talked to your child about concussion						Ever talked to your child about concussion					
	Yes		No				Yes		No			
Variables	**#**	**%**	**#**	**%**	**RR (95% CI)**	**P**	**#**	**%**	**#**	**%**	**RR (95% CI)**	**P**
Yes	90	13.3	48	13.3	1.11 (0.96, 1.27)	**0.1675**	31	12.6	21	9.9	1.13 (0.9, 1.42)	0.3115
No	585	86.7	398	86.7	Ref		216	87.4	192	90.1	Ref	
Has a doctor or other medical professional ever told you that your child had a concussion?												
Yes	121	18.0	18	18.0	1.55 (1.42, 1.7)	**<0.0001**	32	13.0	2	0.9	1.85 (1.62, 2.11)	**<0.0001**
No	552	82.0	427	82.0	Ref		215	87.0	213	99.1	Ref	
Any types of concussion Information Exposure before intervention												
Yes	650	96.2	362	81.0	2.76 (1.94, 3.92)	**<0.0001**	231	93.5	156	72.6	2.75 (1.78, 4.25)	**<0.0001**
No	26	3.8	85	19.0	Ref		16	6.5	59	27.4	Ref	
Intention to talk to child about concussion												
Yes	554	84.8	266	63.0	1.75 (1.48, 2.06)	**<0.0001**	200	85.1	133	65.8	1.74 (1.32, 2.3)	**<0.0001**
No	99	15.2	156	37.0	Ref		35	14.9	69	34.2	Ref	

RR – risk ratio; 95% CI – confidence interval; Ref – reference value

*Percentage (%) in each cell is computed using the total number of no missing records as the denominator. In some cases the respondents had missing data for the covariates

Bold indicates p-value ≤0.2 and variable is entered for model selection.

**Non-Hispanic with race of American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander.

Table 3.

Multivariable analysis: factors associated with parents who ever talked their child about concussion in pre-/post-intervention survey of the centers for disease control and prevention HEADS UP handouts by intervention and control group.

	Talked to your child about concussion			
	Intervention (n = 1002)		Control (n = 381)	
Variables	**aRR**	**P**	**aRR**	**P**
Pre/post intervention				
Pre intervention	ref	**<0.0001**	ref	0.8708
Post intervention	1.33 (1.22, 1.44)		0.99 (0.84, 1.16)	
Race/Ethnicity				
Hispanic	ref	0.6089	ref	0.1890
White non-Hispanic	1.11 (0.95, 1.29)		1.18 (0.86, 1.62)	
Black non-Hispanic	1.07 (0.85, 1.35)		1.04 (0.65, 1.67)	
Other non-Hispanic **	1.10 (0.87, 1.39)		0.77 (0.43, 1.37)	
Education				
Some college or associate degree, High school, Less than high school	ref	**0.0290**	ref	0.3941
Undergraduate degree	0.86 (0.76, 0.96)		1.17 (0.93, 1.48)	
Graduate degree	0.90 (0.81, 1.00)		1.12 (0.89, 1.42)	
Played Basketball, Soccer, football				
Yes	0.96 (0.84, 1.10)	0.5768	1.30 (0.98, 1.71)	**0.0487**
No	ref		ref	
Has a doctor or other medical professional ever told you that your child had a concussion?				
Yes	1.39 (1.27, 1.51)	**<0.0001**	1.72 (1.48, 1.99)	**<0.0001**
No	ref		ref	
Any types of concussion Information Exposure before intervention				
Yes	2.38 (1.65, 3.43)	**<0.0001**	2.73 (1.62, 4.60)	**<0.0001**
No	ref		ref	
Intention to talk to child about concussion				
Yes	1.67 (1.42, 1.96)	**<0.0001**	1.72 (1.31, 2.26)	**<0.0001**
No	ref		ref	

aRR – adjusted risk ratio; 95% CI – confidence interval; Ref – reference value

Added nesting variable to control for people within a specific YMCA.

Bold indicates p-value ≤0.05.

** Non-Hispanic with race of American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander