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Talking with young children about concussions: an exploratory study

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Abstract

Background—Concussion education for children early in their participation in organized sport may help shape lasting attitudes about concussion safety. However, existing programming and research focus on older ages.

Methods—Qualitative interviews about concussions were conducted with twenty children between the ages of six and eight. Structural, descriptive and pattern coding were used to organize the transcribed interviews and identify emergent themes.

Results—Eighteen of the participants indicated that they had heard of the word concussion, with 12 describing the injury as related to the brain or head. The most frequently described mechanisms of injury were impacts to the head or falls, and symptoms tended to be somatic, such as generalized pain. The most frequently endorsed strategy to avoid sustaining a concussion was to 'follow the rules.' Multiple participants referenced parents as an informal source of information about concussions.

Conclusions—While most participants demonstrated some awareness about concussions, there were clear knowledge gaps that can be addressed with developmentally appropriate concussion education programming. Consistent with their developmental stage, interventions targeted at children in this age range may be most successful if they use basic logic, concrete ideas, provide rules to be followed and engage parents in dissemination.

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Disclaimer

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

Keywords

brain injury; children; concussion; parents; sport

Introduction

More than 44 million U.S. youth between the ages of 6 and 18 participate in some form of organized sport (National Federation of State High School Association, 2012; National Council of Youth Sports, 2008). Of those participants, it is estimated that 25% are aged nine and under (National Council of Youth Sports, 2008). Most children who participate in sport do so safely and benefit from positive socialization in the sport context (Eime *et al.* 2013). However, there is also the potential for harm as the result of injury (DiFiori *et al.* 2014). A sport-related injury that has received substantial public attention recently is concussion. Concussion is a form of brain injury that results from biomechanical force transmitted to the head, leading to functional neurologic impairment (McCrory *et al.* 2013). Although symptoms of most concussions are transient and are gone in fewer than two weeks, individuals who have sustained multiple concussions tend to have longer lasting symptoms (Corwin *et al.* 2014; Chrisman *et al.* 2013) and are more likely to experience negative neurological consequences later in life (Iverson *et al.* 2012).

Approximately 3.42 million emergency department visits for sports and recreational related (SRR) TBI occurred between 2001 and 2012, with the overall age-adjusted rate of SRR-TBI Ed visits increasing from 73.1/100 000 in 2001 to 152.00/100 000 in 2012. The highest rates of injury (70% of SRR-TBI) occurred in the 0–19 year age group (Coronado *et al.* 2015). According to emergency department surveillance data released by the Centers for Disease Control and Prevention for 2009–2010, TBI-related emergency department visits occurred at a rate of 889 per 100 000 in children age 5–14 years (Center for Disease Control and Prevention, 2014). In a cohort study, sport-related injuries are estimated to be a primary cause of TBI among children 10 and older (Stewart *et al.* 2014). In sports, the highest concussion incidence rates involve contact or collision, such as football, ice hockey and soccer (Daneshvar *et al.* 2011). Although most contact sports have modified rules for younger children, including limiting body checking in hockey, tackling in football and heading the ball in soccer, these modifications are not universal, and even if present there is nonetheless a risk of brain trauma because of accidental collisions or falls.

The developing brain has a different tolerance for biomechanical forces than does the brain of a fully mature adult, and childhood brain injuries can result in an interruption in the normal course of neurological development (Prins & Giza 2012; Graham *et al.* 2014). Although long-term effects are more likely to occur in moderate to severe brain injuries, evidence is emerging that even children with mild brain injuries such as concussions can experience longer term changes in behavior (Anderson *et al.* 2012; Keightley *et al.* 2014; Liu & Li 2013; Li & Liu, 2013; McKinlay, 2009; Taylor *et al.* 2015). Although more research studies that examine children’s outcomes over time are needed, the current evidence suggests the importance of minimizing children’s risk for brain injury.

Regardless of whether or not children sustain a concussion as a direct result of their participation in sport at a young age, harm from sport can also take the form of learned attitudes towards injury that may put them at higher risk of harm at later ages. Evidence suggests that among adolescent and young adult athletes, at least half continue playing their sport while symptomatic after a concussion (Meehan *et al.* 2013; Llewellyn *et al.* 2014). This means that they are at risk of magnified neurological consequences if an additional impact is sustained prior to full recovery (McCrea *et al.* 2009; Prins *et al.* 2013). In order to receive the necessary care and be removed from activities that might increase harm, young athletes must either report a concussion to their coach or other responsible adult or be identified when the coach or adult observes a concussion event. Evidence from both male and female athletes in high school and older describes a sport ethos where toughness and commitment to the team are demonstrated by playing through pain and injury (Malcolm, 2006; Fenton & Pitter 2010). The sport culture, therefore, contributes to the protective and deleterious youth behaviors regarding injury. Consistent with Social Learning Theory (Bandura 1977), behavioral modeling and reinforcement in the sport context—chiefly from coaches and teammates—provide information about how different behaviors are valued, and play an important role in developing the ethos around sports injuries socializing attitudes towards safety behaviors (Chrisman *et al.* 2013; Kroshus *et al.* 2015). Long-held attitudes and beliefs that are established by cultural norms, and that may potentially have been reinforced in multiple contexts over time, can be difficult to change. By the time athletes make their high school sports teams, many will have been participating in organized sport for more than a decade, with plenty of time for attitudes towards head injuries to become relatively ingrained as a result of social learning processes.

Injury prevention scholars writing about injuries other than sport-related concussion have indicated that one benefit of injury-related intervention at younger ages is that it can have a lasting impact on risk-related attitudes and risk behaviors as the children grow older (Morrongiello *et al.* 2008). The younger children are targeted with developmentally appropriate education about concussions the less time they will be exposed to uncontested cultural messages about sport injury. In a study of adolescents, those aged 13–15 were found to be more receptive to messages about concussion safety than were those aged 16–18 (Bloodgood *et al.* 2013). This does not mean that intervention at older ages is not warranted; Mercy and colleagues (Mercy *et al.* 2003) have described how ‘appropriate interventions conducted over several stages may be more likely to motivate and sustain injury prevention behavior change across a lifetime than a single intervention or a single policy change.’ However, the process of changing the culture of safety in sport needs to start before athletes have perceptions about safety behaviors ingrained.

Despite the seeming importance of concussion education for young children at the outset of their participation in organized sport, no research to date has explored the potential appropriateness of targeting concussion education messaging at this age group. Critically, determining whether children under the age of 10 are an appropriate audience for concussion-related messaging, and the appropriate nature of this messaging, requires considering their developmental stage. Between the ages of six and nine, when many children are beginning their participation in organized sport (National Council of Youth Sports, 2008), individuals tend to be in what Piaget’s theory of cognitive development

classifies as the concrete operational phase (Piaget, 1964). The use of logic is a key characteristic of this phase, as are classification abilities and developing an understanding of the concept of reversibility. Theoretically, children in the concrete operational stage should be able to conceptualize an injury as having specific symptoms, they should be able to identify a series of steps to engage in if they experience symptoms, and understand that with appropriate rest symptoms can go away. Existing evidence indicates that children's conceptions of illness and injury become increasingly sophisticated as they age, with those between the ages of seven and eight typically able to provide relatively accurate information about common childhood conditions including chicken pox, tooth aches and broken legs (Myant & Williams 2005). Symptoms of concussions, unlike many other childhood injuries, are 'invisible' (Andrews 2011), making symptom reporting more difficult to understand than more concrete injuries or illnesses. Because children in the concrete operational phase have difficulty with more abstract concepts, they may have difficulty understanding critical components of concussion. It may be necessary, therefore, to carefully craft interventions for this stage of development that adds tangible aspects to teachings about concussion and such interventions are likely to differ considerably from those designed for adolescent athletes.

Although young children may be one appropriate target for developmentally appropriate concussion education programming—to encourage symptom reporting for injuries sustained during childhood, and to help shape lasting attitudes about concussion safety—most existing concussion education programming tends to be targeted at older ages. There is little existing evidence about concussion-related knowledge and attitudes among athletes under the age of ten. There is, however, existing evidence in other risk-taking domains that cognitions about vulnerability, severity and causality can be modified among even elementary school aged children (Cook *et al.* 2000; Morrongiello & Matheis 2004; Morrongiello & Sedore 2005). A starting point for the creation of appropriate concussion education interventions for children early in their participation in organized sport—and for developing appropriate evaluation strategies for intervention—is understanding the scope of their knowledge about the 'invisible' injury of concussion, including their symptoms and causes, and identifying what they believe to be strategies for risk reduction. The present exploratory qualitative study begins these tasks with structured interviews with 20 six to eight year olds about concussions.

Methods

Sample and recruitment

Participants were recruited from a summer camp located in the metropolitan Boston region. The study was approved by the [blinded for review] Institutional Review Board. Parents of children aged six to eight who were attending the summer camp were invited by email to provide written consent for their child to participate in the research study. Children of consenting parents were subsequently required to provide verbal assent; three of the eligible children did not provide verbal assent and consequently did not participate. Parents who consented to their child participating in the study also provided the child's age and listed the organized sports in which their child had participated in the past 12 months.

Procedure

Data were collected using semi-structured one-on-one qualitative interviews. The interviews lasted on average about 20 min and were audio-recorded and transcribed verbatim. Following the guidelines outlined by Lamb and colleagues (Lamb *et al.* 2007) for conducting interviews with children, a trained interviewer asked each respondent a predetermined and standardized series of questions. The majority of the interview followed a structured protocol, and the predetermined questions were asked in a consistent order. However, following each core question, probes and spontaneous follow-up to encourage elaboration or elicit additional detail were asked. An interview format was selected over a written survey format because of the potential for variability in literacy in this age group (Cain & Oakhill 2008), to allow for contextualization and elaboration of responses and to avoid anchoring respondents to listed choices (Lamb *et al.* 2007).

Following an introductory question in which the participants were asked about the sport or other recreational activities in which they participate in and/or watch on television, the participant was asked if he or she had ever heard of the word concussion. If he or she said yes, they were asked what they know about a concussion. Subsequently, all participants were provided with an age appropriate definition of a concussion so that there was a minimal level of common awareness about the nature of a concussion: ‘A concussion is an injury to your brain. It happens from the brain hitting the inside of your skull. It can happen if you get hit really hard or if you fall down and your head moves back and forth really quickly.’ Possible signs and symptoms of the injury were not provided as part of the definition as this was one of the content areas to be assessed during the structured interview. Participants were subsequently asked if someone experienced a concussion how would they feel, and as appropriate they were prompted to think about symptoms of a concussion, with the example provided that if someone was sick with a cold a symptom could be coughing. Participants were then asked to tell how someone might get a concussion, and how they can avoid getting a concussion.

At the end of the semi-structured interview, participants were asked to indicate if they believed they had previously sustained a concussion. This question was asked at the end of the interview so that the participants would have been maximally exposed to information about concussions to limit response variability in young children with limited concussion knowledge. Subsequently, participants were asked whether they were worried about concussions. This question was asked because, along with the possibility of engendering false positive beliefs about concussion incidence, we were concerned that providing children in this age range with information about concussions might result in them becoming concerned or fearful and that could perhaps result in them modifying their sport or recreation choices.

Data analysis

Interviews were audio-recorded and transcribed verbatim. Initially, a structural coding framework was applied to the data (Namey *et al.* 2008), with the codebook developed based on the topics queried in the interviews. Following this coding framework, responses to ‘what is a concussion’ were classified into subcategories of ‘bodily site,’ ‘mechanism of injury’

and ‘symptoms.’ Responses to ‘what are symptoms of a concussion’ were further classified into categories of somatic, cognitive, emotional and other. After the data were separated into these subcategories, descriptive coding was used to summarize the primary topic of each section of text (Saldana 2009). Where appropriate, open coding, the process by which a label is assigned to a section of text using a word or phrase taken directly from that section of text, was used to record the words used by the participants themselves to describe key dimensions of that category, or in the case of symptoms to describe the symptom that fit into the respective category. As appropriate, pattern coding was used such that the descriptive and open codes were grouped into higher order sets or themes (Miles & Huberman 1994). The frequencies with which particular codes occurred in the text are reported in Tables 1 through 4. In order to capture additional themes not revealed through the structured analytic strategy, all transcripts were reviewed line-by-line by two independent coders for new concepts revealed by the respondents (Auerbach & Silverstein 2003). There were only small number of discrepancies between the two independent coders, and these were resolved by discussion and consensus. From this process, one additional theme was identified: ‘parental influence.’ All passages flagged as referring to parents in any capacity were reviewed on a line-by-line basis and analyzed using descriptive coding to provide a summary of the topic of the selected unit of text (Saldana 2009).

Results

A total of twenty children participated in the study, aged 6 (n = 5), 7 (n = 7), and 8 (n = 8). Twelve of the participating children were male and eight were female. According to their parents, the majority (13) participated in organized soccer. During the initial queries about children’s current activities all participants mentioned sports, with the four most popular being soccer (18), baseball (10), basketball (7) and ice hockey (3). All but one participant indicated that they watch sports on TV. The most viewed televised sports were: soccer (12), football (9), baseball (8), hockey (4) and basketball (4).

Eighteen of the 20 participants indicated that they had heard of the word ‘concussion.’ Participants who had not heard of the word concussion were an eight-year-old boy who plays soccer and a seven-year-old girl who participates in cheerleading. Responses to the question of ‘what is a concussion?’ were broadly grouped into categories of bodily site mentioned and the mechanism of injury. Twelve participants indicated a bodily site of the head and four of the brain. Only one participant did not indicate a specific bodily site, instead referring to a generalized full-body injury. Several of the participants included the mechanism of injury in their definition of a concussion, with an impact to the head (7) or a fall (3) being the most common mechanisms. Only one participant mentioned that concussions could be a sports-related injury. A few participants also mentioned symptoms in their initial concussion definition. The three mentioned were memory issues, headaches or head pain and dizziness, with memory issues being the most common response.

Responses to an open-ended question about symptoms of concussions were grouped into categories of somatic, cognitive, emotional and other in Table 1. Nine participants indicated at least one somatic symptom, with dizziness (6) nausea/vomiting (3) and generalized pain (4) being the somatic symptoms most frequently mentioned. Four participants indicated at

least one cognitive symptom, with memory problems (3) being the cognitive symptom most frequently mentioned. Five participants indicated at least one emotional symptom, with sadness (3) being the emotional symptom most frequently mentioned. Several participants described symptoms that did not fit into any of these three categories, such as ‘weird,’ ‘bad’ and ‘not good.’ Eight of the participants mentioned at least one correct concussion symptom.

The next question participants were asked was ‘How do you get a concussion?’ Sports were referenced in the answers of nine out of the 18 children who provided a response to this question. The specific sports mentioned were golf, basketball, ice hockey, football, soccer and baseball. One child described how a concussion could be sustained as the result of equipment failure while participating in a sport (e.g. ‘playing sports if you get tackled and your helmet falls off’). Fourteen athletes described non-sport reasons for why a concussion could be sustained. Responses, both sport and non-sport, were classified into the following categories: falling, hit or impact to the head, fighting or aggression, not following the rules, not paying attention and equipment failure. Examples provided by the participating children within each of those categories are presented in Table 3.

Categories of responses to the question about how someone could avoid getting a concussion were: follow the rules (5), shoes (3) (e.g. ‘check your laces to make sure they’re tied’), pay attention/be careful (9), avoid being hit by objects (8), avoid hitting objects (3) and helmet use (4). Examples of responses within each of those categories are presented in Table 4.

Seventeen of the 20 participants mentioned their parents at some point during the interview. Parents were most frequently mentioned when participants described watching sports on television, with the majority of respondents indicating that they would watch sports with their parents and most frequently with their dad. Parents were also mentioned when participants were communicating their knowledge about concussions. In describing what she knows about the word concussions, a seven-year-old girl stated: ‘my parents hate them on TV,’ referring to concussions that occur or appear to occur in televised professional sport. In response to the question about what symptoms someone might experience after a concussion, a seven-year-old boy responded: ‘My dad said that your brain can sometimes go numb and it can make you forget stuff.’ An eight-year-old girl who participates in ice hockey and soccer and watched hockey, soccer and baseball on TV described how her parents would talk about concussions sustained by hockey players on television. She reported that her parents would say: ‘Oh my God, he’s got a concussion!’ Another eight-year-old female who participates in sports including gymnastics, taekwondo, soccer and swimming described how when she hit her head and subsequently threw up: ‘It was really annoying, my dad pestered me with questions. It was so—I was like I couldn’t remember my second grade, no my first, no my kindergarten teacher. I couldn’t remember.’ She subsequently indicated that her father is an athletic trainer.

At the end of the structured interview, participants were asked whether they thought they had ever sustained a concussion. Five of the 20 children indicated that they thought they had previously sustained a concussion. Of these five children, one was female (aged eight) and four were male (two aged six and two aged seven). One participant who indicated that she had sustained a concussion provided extensive details about her injury, including her

symptoms and information about how her father, an athletic trainer, had informed her of the diagnosis. Of the four others who responded affirmatively to this question, there was no information available to make inferences validity of their response. All participants were subsequently asked whether concussions are something that they are worried about, to which only two participants responded affirmatively. The reasoning that they provided was, 'They look like it's going to hurt a lot,' and 'I might have to go to the hospital… because I've gone there two times.'

Discussion

The present findings help characterize the concussion knowledge in a small sample of children aged six to eight, an age range during which many U.S. children begin participation in organized sport. In describing how children in this sample view concussions, and in linking these findings with existing developmental literature, this study helps suggest the opportunities for and limits to individually oriented concussion education targeted at young athletes in this age range.

The majority of the participants in the present study had heard of the word concussion, and many had a generally correct sense of the nature of concussions, mentioning a bodily site of the head or brain, and a mechanism of bumping, hitting or shaking. The concussion symptoms described by participants tended to be somatic, such as feeling dizzy, throwing up or having a headache. Emotional or cognitive symptoms were less frequently described. This is perhaps not surprising given participants' developmental stage. Logic and concrete thinking are key characteristic of what Piaget's theory of cognitive development classifies as the concrete operational phase (Piaget, 1964). The connection between somatic symptoms and brain trauma may be relatively straightforward and consistent with other injuries where the result of an impact is a scrape or pain. Symptoms that are more abstract (e.g. memory and emotional symptoms), that are not obviously and concretely associated with the head or brain, or that occur over time after an impact may be understandably viewed as less connected to the event and more difficult for children to identify.

Most of the participants who described how someone playing a sport could get a concussion described a very specific situation in which the injury could occur (e.g. 'if you get tackled and your helmet falls off') rather than invoking sports participation in general. The examples provided are relatively concrete—describing specific situations rather than generalized risk processes—and show children's level of thinking about the injury (concrete operations) and their developing ability to understand relationships between events and processes. To the extent educational programs for young children provide information about how concussions occur, a useful approach may be to provide concrete examples that are connected directly to activities in which they commonly participate.

Strategies described by the children for avoiding a concussion were in the following categories: follow the rules, shoes, pay attention/be careful, avoid being hit by objects, avoid hitting objects and helmet use. Nine of the 20 children mentioned at least one example of following the rules or being careful, and these two categories were the most frequently described, with 14 different examples when combined. This reflects the idea that children in

the concrete operational stage of Piaget's developmental theory tend to believe that health comes from following specific rules (Perrin & Gerrity 1981). The second most common group was avoiding being hit by objects, which was mentioned eight times. Although many participants believed that they could avoid concussions by being careful and following the rules, there appears to be an understanding that concussions could be caused by something outside of the participant's control. Consequently, in devising educational materials for this age group, it is important to identify specific points or 'rules' for children to follow. Examples of rules might be requiring adult supervision for certain activities, or always using protective equipment.

Despite the absence of questions about parents in the structured interviews, most children spontaneously mentioned their parents in some capacity. For several, this included describing how a parent has taught them about concussions, or helped them identify their own concussion. Most of the participants mentioned watching sports on TV with a parent, a situation that presents opportunities for observational learning about concussions and can act as a conversation starter about concussion safety. Parents play a central role in educating children about health and safety: children's attitudes and behaviors for both health and sports are learned starting at a young age from their parents (Tinsley 1992; White *et al.* 2004). Understanding how and why parents communicate with children about health and safety, and how existing literature suggests they can do so most effectively, can help inform effective educational program development related to concussions. Motivation for health and safety rule teaching is based on parent belief that injuries are preventable as well as their own attitudes and experiences about health (Tinsley & Lees 1995; Morrongiello *et al.* 2014). Recent findings revealed parent misconceptions about identification and management of concussions in children (Mannings *et al.* 2014; Lin *et al.* 2015). However, at present, there exists little evidence about how parents contribute to shaping their knowledge and attitudes among athletes under the age of 10. Across other injury domains, parents begin by teaching home safety rules to children as young as two years and continuing over time by adding more rules as children age.[61] The influence of parents as part of young children's view of injuries, prevention and when to seek care is particularly critical when examining methods for child messaging. Especially during early childhood, parents support children's learning about health and safety in the context of their parenting practices and home environment in a process termed as 'scaffolding' in which they tailor their teaching to children's level of cognitive development to help them extend their knowledge to a higher level of competence (Tinsley & Lees 1995). Beginning in 2005, the Heads Up program was developed to provide parents information about concussion symptoms (http://www.cdc.gov/headsup/youthsports/parents.html). Providing parents with information about concussions as well as guidance on how to effectively facilitate developmentally appropriate conversations about concussion safety with young children as they age is a practice to be explored. Future research is needed on the effectiveness of this approach.

Limitations

There are limitations to this qualitative, exploratory study. A primary limitation is its lack of generalizability. The sample was recruited from a summer camp in a middle class suburb in the northeast of the United States. Given the role that parents play in educating children

about health and safety (Morrongiello *et al.* 2014), and the existing evidence that indicates there is often a socioeconomic gradient in health literacy (Yin *et al.* 2009), it is possible that there are differences in child knowledge about concussions that are patterned on family socioeconomic status. In the population as a whole, only one quarter of children begin organized sports participation before the age of nine, whereas in the present sample 18 out of 20 participated in organized sports according to a parent. Based on this difference, it is possible that children from more affluent families begin participating in organized sports at an earlier age than their less affluent peers. Participating in organized sport may provide opportunities for observational learning about sport injury and concussions to the extent one is sustained by a teammate or competitor. This may be another reason why the findings from the present sample are not generalizable to all U.S. children aged six to eight.

Conclusions

The present study provides insight into children's concussion knowledge and beliefs at a time when they are entering organized sports. Findings indicate that between ages 6 and 8 years, they tend to have a reasonably accurate, although limited, conceptions about concussions. Consistent with the Piaget's concrete operational phase, the participants in this study tended to identify symptoms that were most obviously connected to the head or brain, and to view concussions as something that could be prevented by following rules. Based on these findings, and drawing on developmental literature, interventions targeted at children in this age range may be most successful if they use basic logic and concrete ideas and provide rules to be followed. When describing more complex or abstract concepts (such as concussion symptoms that are not as readily connected to the head or brain) using simple models or animations may help make these concepts more concrete. Because parents are intricately involved in educating young children about health and safety, they may be one appropriate channel through which concussion education could be disseminated. While the present findings can help provide a starting point for the design of developmentally appropriate concussion education, as a qualitative, exploratory study with a small sample of children the findings must be considered preliminary, and should be supplemented by additional work in a larger and more generalizable sample.

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Key messages

- Children between the ages of 6 and 8 appear to have reasonably accurate, although limited, conceptions about concussions.
- Symptoms identified were those that were most obviously connected to the head or brain
- Concussions were viewed as something that could be prevented by following rules.
- Interventions targeted at children in this age range may be most successful if they use basic logic and concrete ideas and provide rules to be followed.

Table 1

Response to the question ‘What is a concussion?’

	n	%
Heard of the word concussion		
Yes	18	90.0
No	2	10.0
Bodily site		
Head	12	60.0
Brain	4	20.0
Generalized	1	5.0
Mechanism of injury		
Hit/bang head	8	40.0
Fall	3	15.0
Brain gets dislocated/out of place	2	10.0
Brain shakes	1	5.0
Pieces of skull get out of place	1	5.0
Sports related injury	1	5.0
Symptoms		
Memory problems	4	35.0
Generalized pain	2	10.0
Dizzy	2	10.0
Nauseous/vomiting	2	10.0
Headache	1	5.0
Sleepy	1	5.0
Blurry vision	1	5.0
Other (brain goes numb, bad for your body, sit out of sports)	3	15.0

Note: 3 of the 20 children were not able to come up with unprompted information about the word concussion

Table 2

Concussion symptoms provided in open-ended response after having received a basic definition for the mechanism through which a concussion can occur

	n	%
Symptoms		
Somatic symptoms		
Dizzy	6	30.0
Pain (generalized)	4	20.0
Nauseous/vomiting	3	15.0
Headache/brain would hurt	2	10.0
Get sleepy/feel faint	1	5.0
Blurry vision	1	5.0
Sneezing	1	5.0
Cognitive		
Memory problems	3	15.0
See black	1	5.0
Emotional		
Sad	3	15.0
Angry	1	5.0
Upset at making a mistake	1	5.0
Crying	1	5.0
Scared	1	5.0
Other		
Weird	2	10.0
Bad	2	10.0
Not good	2	10.0
Fat	1	5.0

The following definition was provided prior to the question about symptoms: ‘A concussion is an injury to your brain. It happens from the brain hitting the inside of your skull. It can happen if you get hit really hard on the head or if you fall down and your head moves back and forth really quickly.’ Possible signs and symptoms of the injury were not provided as part of the definition.

Table 3

Responses to question ‘How can you get a concussion?’

Code	*n* (%)	Examples (age, sex)
Falling	11, (55.0)	‘If you are doing sport and they trip and fall’—(8, F) ‘Falling down on like gravel’ ‘Because they fell down too hard’—(6, F) ‘Or if for some reason there was foul or someone tripped them and they fell’—(6, F)
Hit/impact to head	14, (70.0)	‘Getting kicked in the head by a soccer ball’—(7, M) ‘If it’s hailing, they’re going to be hit by ice’—(7, M) ‘During hockey the puck could hit you’—(8, F) ‘A brick falls off a building, or you get hit with a huge hailstone’—(9, M) ‘If someone threw a ball and it hit them in the head’—(6, F)
Fighting/aggression	3, 1 (5.0)	‘Getting punched in the face too hard’—(7, M) ‘You could get tripped’—(7, M) ‘Someone on their team or the other team tries to injure them’ —(7, M)
Not following the rules	2, (10.0)	‘If they’re like fooling around or like horse playing.’—(8, F) ‘Maybe say they were running in the house and they fell’—(8, M)
Not playing attention	3, (15.0)	‘Because they’re not paying attention—(7, M) ‘You didn’t know that the pole was right there and you smash your head into the pole’—(8, M) ‘If you’re not looking where you are going, and you whack your head into a light pole’—(8 M)
Equipment failure	2, (15.0)	‘At sports, you could be tackled and your helmet could fall off’—(7, M) ‘The golf club could swing back and hit you on the head’—(8, F)
Other	1, (5.0)	‘Someone shouting too loud or shouting too much’—(7, M)

Table 4

Responses to question ‘How can you avoid a concussion?’

Code	*n* (%)	Examples (age, sex)
Follow the rules	5, (25.0)	‘Don’t fool around’—(8, F) ‘By playing safe’—(7, M) ‘Not play a sport, except when you’re supposed to’—(7, F) ‘By not running’—(7, M) ‘Asking if I can play older kid games’—(7, M) ‘Not playing things where you could get hit on the head’—(7, M)
Shoes	3, (10.0)	‘Don’t wear shoes that are too big for you’—(8, F) ‘Be careful where you step when you’re wearing soccer cleats’—(8, M) ‘Check your laces to make sure they’re tied’—(8, M)
Pay attention/be careful	9, (45.0)	‘Be aware of your surroundings when playing sports’—(8, M) ‘Be careful when playing sports’—(8, F) ‘Look where you are going’— (8, M) ‘Only do things you know how to do, don’t try risky stuff’— (8, M) ‘Paying attention’— (7, M) ‘Not playing things where you get hit on the head.’—(7, M) ‘Trying not to fall’— (6, F)
Avoid being hit by objects	8, (40.0)	‘Don’t let people throw rocks at you’,—(7, M) ‘Stop things from hitting you on the head’—(7, M) ‘Cover my head with my hand’—(7, F) ‘Ducking when the baseball is going to get thrown at my head’—(7, M) ‘Move’—8, M
Avoid hitting objects	3, (15.0)	‘Don’t run into people’— (8, M) ‘When you are playing football, don’t ram your head into a guy’—(8, M) ‘If you’re playing basketball, jumping up in front of the ball, or even just jumping up when you’re trying to dunk, boom, [you] hit your head on the hoop’—(8, M)
Helmet use	4, (20.0)	‘Wear a helmet when I’m playing sports’—(7, M) ‘If you have a helmet on, keep it on’— (6, M) ‘If you’re playing hockey without a helmet don’t try to be like a pro NHL hockey player’—(8, M)