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# Concussion knowledge and experience among a sample of American adults

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## Abstract

**Background:** Recently, there has been a strong emphasis on educating athletes, parents, coaches, and health care providers about concussions. However, not much is known about whether these efforts are affecting the general public's level of concussion knowledge.

**Purpose:** To determine what is currently known among the public about concussions and where education campaigns may be targeted in order to fill in the gaps.

**Methods:** In order to achieve the project's objective, CDC analyzed self-reported data from Porter Novelli's 2017 SummerStyles survey, an annual survey of American adults aged 18 and older across the United States. The questions focused on personal concussion experiences, basic concussion knowledge, knowledge of prevention strategies, and perceived best sources of information about concussion.

**Results:** Analysis of the data showed that approximately 18% of respondents reported that they had personally experienced a concussion in their lifetime, and about two-thirds of these respondents were evaluated by a health care provider after their injury. In terms of concussion knowledge, the majority were aware of common causes of concussion. While 94% knew that headache was a symptom of concussion, just over half were aware that sleep problems were as well. Most respondents (>78%) correctly identified that wearing seat-belts, preventing falls, and reducing participation in contact sports were ways to prevent a concussion, while installing baby-gates across stairs was less frequently known (65.5%) as a prevention technique. Nearly all of the respondents believed that a doctor or other health professional was a good source of information about concussions. These results varied by age, sex, race/ethnicity, and education.

**Conclusion:** The results demonstrate that even though the public has a relatively high knowledge level of concussion, targeted education is needed to teach American adults about the symptoms and ways of getting a concussion.



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**Keywords**

Concussion; knowledge; prevention

## Introduction

A concussion is a mild traumatic brain injury (TBI) that results in disruption of the normal function of the brain. Despite difficulties with determining concussion prevalence in the United States, survey researchers estimate that upwards of 12–20% of adolescents and adults have experienced a concussion or TBI at some point in their lifetimes.[1] The subject of concussion has recently exploded into the public's consciousness, in large part due to research into and media coverage of the risks of repeated collisions in contact sports, particularly American football. There has been a concomitant focus on educating coaches, youth athletes, and the parents of these athletes on the risks of concussion, and recognition of and responding properly when a concussion occurs. For example, the U.S. Centers for Disease Control and Prevention (CDC) developed the HEADS UP campaign (www.cdc.gov/headsup/) to raise awareness of this and other issues about concussion safety in all youth athletics. In recent years, research studies have found that student athletes have a relatively high level of knowledge about concussions, including their causes and symptoms.

Despite the proliferation of educational and research campaigns which target sports-induced concussions in children/adolescents, this injury can happen to anyone regardless of their age. A study by Taylor et al. found that older adults ≥75 years old and children 0–4 years old had the highest rates of TBI-related emergency department visits compared to other age groups. However, there is a lack of information about what the general public knows about concussions and TBIs. Earlier studies (i.e., before passage of U.S. state concussion laws such as Washington state's Zachary Lystedt law) found that the public had significant misconceptions regarding the causes, symptoms, recovery course, and risks of concussion and TBI.[2–5] Not much is known about where the public goes for sources of information about TBI and whether or not they sought medical attention for their injury. In addition, a more recent study discovered that there was significant uncertainty about what a concussion was and how it should be managed and a 2015 Harris poll demonstrated that while more than 50% of US adults correctly identified general symptoms of a concussion (e.g., headache at 58%, dizziness or motion sensitivity at 58%, and cognitive difficulty at 55%), other symptoms were identified less often (e.g., vomiting at 42%, fatigue at 34%, slurred speech at 31%, and changes in mood at 13%). Given the frequency of and concern about concussions, this paper aims to determine what is currently known among the general public about concussions and where education campaigns may be targeted in order to fill in the gaps. In addition to asking and analyzing common questions related to sports-related concussions, we also put a particular focus on assessing knowledge of other causes of concussion and on determining the best vehicles for future concussion education. Determining where gaps in knowledge lie and what the best sources of information are for filling these gaps is critical to the field of concussion prevention.

## Methods

### Sample

Self-reported data were collected from the summer wave of Porter Novelli's 2017 ConsumerStyles database called SummerStyles. This is an annual voluntary web-based survey that gathers insight about the health experiences, attitudes, and behaviors of American adults aged 18 and older. Using an already existing survey panel, between 7 June and 2 July 2017 Porter Novelli randomly sent 5586 of the panel's adults aged 18 years or older the survey. Survey completion took approximately 26 min and a total of 4107 respondents completed the survey for a response rate of 74%. The CDC licensed the results of the survey from Porter Novelli after data were collected. CDC's analyses were exempt from institutional review board approval because personal identifiers were not included in the data file.

### Measures

Survey respondents were asked questions focused on personal concussion experience, basic concussion knowledge, knowledge of recovery and prevention strategies, and perceived best sources of information about concussion (please refer to Tables 1 to 6 to see the entire question and response options).

#### Questions included:

- Personal concussion experience
  - Have you or someone you know ever had a concussion?
  - If you personally experienced a concussion, were you evaluated by a doctor or other healthcare provider for a concussion?
- Concussion knowledge
  - What are some of the ways you can get a concussion?
  - What are some of the symptoms of a concussion?
- Prevention strategies
  - What are some ways to prevent a concussion?
- Sources of concussion information
  - What do you think are good sources of information about concussions?

### Data analysis

All data were analyzed using SAS 9.4 (SAS Institute Inc., Cary, NC) and SPSS (V.24, SPSS, Chicago). Frequency distributions were calculated for each question and chi-square results were analyzed by key demographics (age, sex, education, and ethnicity). Uncorrected post hoc tests were also performed if the chi-square results were significant, $p < 0.05$, to determine where the differences lie for each individual group.

# Results

## Frequency distributions

The SummerStyles respondents were approximately evenly split between men (48.8%) and women (51.2%). About 14% of the sample was aged 18–29, 24.9% were 34–44, 32.1% were 45–59, and 28.7% were aged 60 or older. Nearly two-thirds of respondents were currently married. About 73% identified as non-Hispanic white, 12.1% as Hispanic, 9.0% as non-Hispanic black, and 5.8% as non-Hispanic other. The sample was relatively evenly split across educational categories and more than two-thirds had an annual household income of $50,000 or more. More than 85% of respondents lived in a metropolitan area and they were well-dispersed across the four census regions of the United States.

## Personal concussion experience

Table 1 shows that 18.1% of respondents reported having had a concussion, while 24.0% have not had a concussion but know someone who has. About one in ten respondents were not sure if they or anyone they know has ever had a concussion. There was an association between personal concussion experience and sex ($x^2(3) = 75.15$, $p < 0.0001$). Male respondents were more likely to have had a concussion (20.7%) than female respondents (15.5%) (post hoc $p < 0.0001$). Concussion experience also varied by age ($x^2(9) = 62.26$, $p < 0.0001$), race/ethnicity ($x^2(9) = 81.52$,= $p < 0.0001$), and education ($x^2(6) = 94.00$, $p < 0.0001$). For example, a greater proportion of respondents aged 45–59 reported that they have had a concussion (22.2%) compared to respondents of all other age groups (post hoc $p$s $< 0.048$). Additionally, a greater proportion of respondents who were non-Hispanic white indicated they have had a concussion (19.7%) compared to respondents who were non-Hispanic Black (11.1%) or Hispanic (13.9%) (post hoc $p$s $< 0.01$); and a greater proportion of respondents with some college (20.5%) or a Bachelor's degree or higher (20.2%) reported that they have had a concussion compared to respondents with a high school degree or less (14.3%) (post hoc $p$s $< 0.0001$) (Table 1).

Table 2 shows that of the respondents who have had a concussion, two-thirds were evaluated by a doctor or other health care provider. Females who have had a concussion were more likely to have been seen by a medical provider (76.0%) than males (61.4%) ($x^2(2) = 17.28$, $p < 0.0001$). There were no significant differences on this variable by age, race/ethnicity, or education.

## Concussion knowledge

As seen in Table 3, more than 9 in 10 respondents knew that one can get a concussion through sports and recreation, a fall, motor vehicle crash, and assault or other forms of violence. About 84% also knew that a blast or explosion can cause a concussion. Knowledge about concussion causes varied by demographic factors (see Table 3 for individual $x^2$ values).

A significant proportion of respondents also recognized some of the common symptoms of a concussion; specifically, 94.9% recognized problems with balance or dizziness and 93.8% recognized headache as symptoms (Table 4). Other symptoms were recognized less

frequently: 70.0% knew that changes in mood and/or behavior and 53.3% knew that sleep problems can be symptoms of a concussion. Fever (11.0%) and loss of sense of smell (27.7%) were incorrectly identified as concussion symptoms by a small proportion of respondents.

Table 4 shows that a similar pattern was also evident for demographic differences in relation to the recognition of symptoms of a concussion. For instance, a greater percentage of non-Hispanic white respondents recognized headache, problems with balance or dizziness, changes in mood and/or behavior, and sleep problems as symptoms of a concussion ($p$s < 0.0001), compared to all other race/ethnicity groups.

### Prevention strategies and information about concussions

Most respondents correctly identified that wearing a helmet in sports and recreation (95.7%), wearing seat-belts (89.8%), preventing falls (89.1%), and reducing participation in contact sports (78.1%) were ways to prevent a concussion (Table 5). Installing baby-gates across stairs was less frequently known (65.6%) as a prevention technique. There were also demographic differences in how respondents answered questions about specific ways to prevent a concussion (see Table 5 for full results). For example, males more often correctly identified that reducing participation in contact sports ($x^2(1) = 12.05, p = 0.0005$) and females more correctly identified that installing baby gates across stairs ($x^2(1) = 15.26$, $p < 0.0001$) can prevent concussions. A greater proportion of non-Hispanic white respondents and respondents with more education correctly identified that reducing participation in contact sports, wearing a seat-belt, preventing falls, and installing baby gates across stairs are ways to prevent concussions ($p$s < 0.002) than other race/ethnic and education groups.

Doctors or other health professionals (95.0%) were overwhelmingly the preferred sources of information about concussions, followed by government resources such as the CDC and public health departments (57.3%), coaches (29.7%), TV/magazines/movies/newspapers (20.1%), friends (12.7%), social media (10.7%), and other sources (4.1%) (Table 6). These responses varied by demographic characteristics as well. Females and older respondents were more likely to identify that doctors or other health professionals, TV/magazines/movies/newspapers, and social media as good sources of information ($p$s < 0.04) than males and younger respondents. Both non-Hispanic white (58.1%) and non-Hispanic other (62.3%) respondents were more likely to indicate that government resources such as the CDC and public health departments were good sources of information about concussions than other race/ethnicity groups ($x^2(3) = 10.98$, $p = 0.0118$).

## Discussion

Despite the fact that all age groups are at risk for experiencing a concussion or TBI, most research and educational programs focus on youth or young adult athletes.[7] This is one of the first studies to examine a sample of the general population across the adult age span regarding personal concussion experience and level of knowledge. Our analysis showed that nearly one in five respondents had personally had a concussion while another 24.0% knew someone who has had one, which is similar to other survey results.[8] These percentages alone demonstrate just how pervasive concussion is among American adults. Concussion

experience did vary by demographic characteristics, though, which is consistent with some previous research. For example, we found that men were more likely to report having experienced a concussion than women. Studies have generally found that men have higher rates of concussion than women; however, this pattern may be reversing among athletes.[7] Similarly, our study shows that a higher proportion of non-Hispanic white respondents have had a concussion than other groups. Veliz et al. also found that among a large sample of adolescents, white teenagers were more likely to report a diagnosed concussion than other race/ethnicity groups. About two-thirds of our respondents who reported having experienced a concussion were evaluated by a doctor for the injury. This speaks to the issue of undiagnosed concussions that have been previously reported in the literature[8] and the need to account for such injuries in estimates.

Concussion knowledge varied widely depending on the topic at hand. For instance, respondents were fairly well-versed in common causes of concussion (e.g., >90% could identify three of the top causes of concussion—sports and recreation, falls, and motor vehicle crashes) and ways to prevent concussions. However, a smaller percentage of respondents could identify all the listed symptoms of a concussion. For example, only about half of the respondents identified sleep problems, which can be a common complaint among those who sustain a concussion.[9] Previous studies have demonstrated that people tend to be familiar with certain concussion symptoms—e.g., headache, dizziness, loss of consciousness—and not others.[7] In general,women, older individuals, non-Hispanic whites, and those with a Bachelor's degree or higher were slightly more likely to correctly identify causes of concussion than men, younger individuals, other race/ethnicity groups, and those with lesser educational attainment. This pattern of knowledge by demographic groups closely matches Lin et al.'s findings that white women and those with higher income and educational attainment generally possess more concussion knowledge and/or safer concussion attitudes. A similar pattern existed for the identification of correct concussion symptoms, however, there was more variability among the age groups.

In terms of knowledge of concussion prevention, 90–95% of respondents recognized that wearing a helmet during sports and recreation activities, wearing a seat-belt in the car, and preventing falls are good ways to help prevent concussions. Fewer respondents knew that reducing contact sports participation or installing baby gates across stairs were also effective means of concussion prevention. Unfortunately, most previous research has focused solely on concussion prevention in sports;[7] thus, it is difficult to determine if these results are in line with other studies. However, recently more public health and advocacy groups are incorporating concussion prevention information that reach outside the scope of sports.[9] In sum, these results indicate that concussion knowledge is somewhat variable across the population; however, concussion-related knowledge does appear to be relatively high among all groups. Therefore, it is important for a public health professional to harness this awareness about concussions to ensure actual behavior change to prevent concussions.

There are several limitations to this study. First, the knowledge and prevention questions from the survey asked "recognition-type" questions in which answer choices are provided to the respondent. These types of questions have been shown to provide a potentially inflated sense of what the public knows about concussions. On the other hand, questions that rely on

recall, in which the respondent has to provide the answer, have been shown to be more difficult to respond to and might better reflect respondents' true knowledge since they have to come up with the answer on their own. Second, for four category multiple choice or binary questions (Yes/No), respondents will correctly identify an answer by chance 25% and 50% of the time, respectively. Therefore, the results should be considered in relation to these percentages. Third, there might be differences in concussion knowledge between responders and nonresponders, which could have resulted in biased results.

## Conclusion

This study is one of the first to examine the level of concussion knowledge among a sample of the general population, how experience and knowledge vary by a variety of demographic factors, knowledge of nonsports-related concussion causes, and from what source people prefer to receive concussion information. The results of this study indicate that there is room for improvement regarding concussion knowledge and prevention. While this study utilized a convenience sample, the results about concussion experience and knowledge mirror previous studies. Therefore, this study should provide useful information about the general public's knowledge of concussion and prevention strategies to public health professionals interested in creating and disseminating concussion education materials and programs for a general audience. These data show that preferred routes for dissemination include doctor or other health professionals and government resources, so these routes should be emphasized. There is growing media attention and public awareness surrounding concussions,' demonstrating concern and interest in learning about concussion prevention and recognition; this report provides further information about how to focus new or existing campaigns.

## Disclaimer

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

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**Table 1.**

Frequency and percentage of respondents who answered the question “A concussion is when a blow or jolt to the head causes problems such as being dazed or confused, difficulty remembering or concentrating, vomiting, blurred vision, or being knocked out. Have you or someone you know ever had a concussion?”, by gender, age, race/ethnicity, and education.

| | I have had a concussion | I have not had a concussion, but I know someone who has | I have not had a concussion and I do not know anyone who has had one | I am not sure if I or anyone I know has ever had a concussion | Comparison statistic |
|---|---|---|---|---|---|
| Total: frequency (%) | 740 (18.1) | 983 (24.0) | l940 (47.4) | 432 (l0.5) | |
| *Sex* | | | | | $\chi^2(3)=75.l527$, $p<0.000l$ |
| Males | 414 (20.7) | 374 (l8.7) | 959 (48.0) | 250 (l2.5) | Cramer’s $V=0.l3$ |
| Females | 326 (l5.5) | 609 (29.0) | 98l (46.8) | l82 (8.7) | |
| *Age* | | | | | |
| 18–29 | 94 (16.0) | l50 (25.6) | 264 (45.l) | 78 (l3.3) | $\chi^2(9) = 62.2569$, $p<0.000l$ |
| 30–44 | 192 (18.8) | 275 (26.9) | 456 (44.7) | 98 (9.6) | Cramer’s $V=0.07$ |
| 45–59 | 291 (22.2) | 320 (24.4) | 585 (44.6) | ll7 (8.9) | |
| 60 or older | 163 (l3.9) | 238 (20.3) | 635 (54.0) | l39 (ll.8) | |
| *Race/ethnicity* | | | | | $\chi^2(9) = 8l.5222$, $p<0.000l$ |
| Non-Hispanic White | 589 (19.7) | 792 (26.5) | l308 (43.7) | 305 (l0.2) | Cramer’s $V=0.08$ |
| Non-Hispanic Black | 41 (ll.l) | 62 (l6.8) | 222 (60.2) | 44 (ll.9) | |
| Non-Hispanic Other | 41 (l7.3) | 42 (l7.7) | l27 (53.6) | 27 (ll.4) | |
| Hispanic | 69 (l3.9) | 87 (l7.6) | 283 (57.2) | 56 (ll.3) | |
| *Educational attainment* | | | | | $\chi^2(6) = 94.0043$, $p<0.000l$ |
| High school or less | 222 (l4.3) | 3l4 (20.3) | 80l (5l.6) | 2l4 (l3.8) | Cramer’s $V=0.l0$ |
| Some college | 250 (20.5) | 274 (22.5) | 565 (46.4) | l30 (l0.7) | |
| Bachelor’s degree or higher | 268 (20.2) | 395 (29.8) | 574 (43.3) | 88 (6.6) | |

**Table 2.**

Frequency and percentage of respondents who answered the question “Were you evaluated by a doctor or other healthcare provider for a concussion?”, by gender, age, race/ethnicity, and education.[a]

| | Yes | No | Comparison statistic |
|---|---|---|---|
| Total: frequency (%) | 488 (67.9) | 23l (32.l) | |
| *Gender* | | | $\chi^2(2) = 17.28$, $p < 0.000l$ |
| Males | 247 (6l.4) | l55 (38.6) | Cramer’s $V = 0.l5$ |
| Females | 24l (76.0) | 76 (24.0) | |
| *Age* | | | $\chi^2(3) = 3.98$, $p = 0.27$ |
| l8–29 | 59 (63.4) | 34 (36.6) | |
| 30–44 | l22 (64.2) | 68 (35.8) | Cramer’s $V = 0.07$ |
| 45–59 | l94 (69.0) | 87 (3l.0) | |
| 60 or older | ll3 (72.9) | 42 (27.l) | |
| *Race/ethnicity* | | | $\chi^2(3) = l.55$, $p = 0.67$ |
| Non-Hispanic White | 384 (67.l) | l88 (32.9) | Cramer’s $V = 0.05$ |
| Non-Hispanic Black | 26 (65.0) | l4 (35.0) | |
| Non-Hispanic Other | 28 (73.7) | l0 (26.3) | |
| Hispanic | 50 (72.5) | l9 (27.5) | |
| *Educational attainment* | | | $\chi^2(2) = 0.85$, $p = 0.65$ |
| High school or less | l42 (66.4) | 72 (33.6) | Cramer’s $V = 0.03$ |
| Some college | l7l (70.l) | 73 (29.9) | |
| Bachelor’s degree or higher | l75 (67.l) | 86 (33.0) | |

[a]Only asked of those who answered “Yes, I have had a concussion” to “A concussion is when a blow or jolt to the head causes problems such as being dazed or confused, difficulty remembering or concentrating, vomiting, blurred vision, or being knocked out. Have you, or someone you know, ever had a concussion?”

**Table 3.**

Frequency and percentage of respondents who answered the question “What are some of the ways you can get a concussion?”, by gender, age, race/ethnicity, and education.

| | Sports and recreation | Comparison statistic | A fall | Comparison statistic | Blast or explosion | Comparison statistic | Vaccine[a] | Comparison statistic | Motor vehicle crash | Comparison statistic | Assault and other forms of violence | Comparison statistic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total: frequency (%) | 3894 (95.0) | | 3885 (94.8) | | 3432 (83.7) | | 70(1.7) | | 3902 (95.2) | | 3818 (93.1) | |
| *Gender* | | $\chi^2$(l)=6.24, *p*=0.01 | | $\chi^2$(l)=5.07, *p*=0.02 | | $\chi^2$(l)=10.34, *p*=0.0013 | | $\chi^2$(l)=0.002, *p*=0.97 | | $\chi^2$(I) = 6.41, *p*=0.01 | | $\chi^2$(I)=5.14, *p*=0.02 |
| Males | 1883 (94.1) | Cramer’s *V*=0.04 | 1880 (94.0) | Cramer’s *V*=0.03 | 1713 (85.6) | Cramer’s *V*=0.05 | 34(1.7) | | 1881 (94.3) | Cramer’s *V*=0.04 | 1845 (92.2) | Cramer’s *V*=0.03 |
| Females | 2011 (95.8) | | 2005 (95.5) | | 1719 (81.9) | | 36 (1.7) | | 2015 (96.0) | | 1973 (94.0) | |
| *Age* | | $\chi^2$(3)=25.09, *p*<0.0001 | | $\chi^2$(3)=41.34, *p*< 0.0001 | | $\chi^2$(3)=6.43, *p*=0.09 | | $\chi^2$(3)=16.37, *p*=0.00l0 | | $\chi^2$(3)=36.29, *p*<0.0001 | | $\chi^2$(3)=33.29, *p*<0.0001 |
| 18–29 | 542 (92.2) | Cramer’s *V*=0.08 | 536 (91.2) | Cramer’s *V*=0.l | 477 (81.1) | | 20 (3.4) | Cramer’s *V*=0.06 | 540 (91.8) | Cramer’s *V*=0.09 | 529 (90.0) | Cramer’s *V*=0.09 |
| 30–44 | 952 (93.4) | | 943 (92.5) | | 846 (83.0) | | 22 (2.2) | | 950 (93.2) | | 925 (90.8) | |
| 45–59 | 1263 (95.8) | | 1269 (96.2) | | 1128 (85.0) | | 15(1.1) | | 1274 (96.6) | | 1238 (93.9) | |
| 60 or older | 1137 (96.9) | | 1137 (96.9) | | 981 (83.6) | | 13 (l.l) | | 1138 (96.9) | | 1126 (95.9) | |
| *Race/ethnicity* | | $\chi^2$(3)=61.76, *p*<0.0001 | | $\chi^2$(3)=53.05, *p*<0.0001 | | $\chi^2$(3)=104.04, *p*<0.0001 | | $\chi^2$(3)=10.50, *p*=0.01 | | $\chi^2$(3)=64.15, *p*<0.0001 | | $\chi^2$(3)=82.03, *p*<0.0001 |
| Non-Hispanic White | 2897 (96.5) | Cramer’s *V*=0.12 | 2889 (96.3) | Cramer’s *V*=0.l1 | 2608 (86.9) | Cramer’s *V*=0.16 | 43 (1.4) | Cramer’s *V*=0.05 | 2903 (96.7) | Cramer’s *V*=0.13 | 2859 (95.3) | Cramer’s *V*=0.14 |
| Non-Hispanic Black | 329 (89.4) | | 330 (89.7) | | 254 (69.0) | | 9 (2.5) | | 328 (89.1) | | 320 (87.0) | |
| Non-Hispanic Other | 212 (89.5) | | 218 (92.0) | | 196 (82.7) | | 2 (0.8) | | 220 (92.8) | | 211 (89.0) | |
| Hispanic | 456 (92.3) | | 448 (90.7) | | 374 (75.7) | | 16 (3.2) | | 451 (91.3) | | 428 (86.6) | |
| *Educational attainment* | | $\chi^2$(2)=29.21, *p*<0.0001 | | $\chi^2$(2)=17.31, *p*=0.0002 | | $\chi^2$(2)=75.55, *p*<0.0001 | | $\chi^2$(2)=0.34, *p*=0.84 | | $\chi^2$(2)=27.74, *p*<0.0001 | | $\chi^2$(2)=29.28, *p*<0.0001 |
| High school or less | 1435 (92.6) | Cramer’s *V*=0.08 | 1441 (93.0) | Cramers *V*=0.07 | 1200 (77.5) | Cramer’s *V*=0.14 | 26(1.7) | | 1440 (93.0) | Cramer’s *V*=0.08 | 1401 (90.5) | Cramer’s *V*=0.14 |
| Some college | 1176 (96.0) | | 1165 (95.1) | | 1052 (85.9) | | 23 (1.9) | | 1176 (96.0) | | 1153 (94.1) | |
| Bachelor’s degree or higher | 1283 (96.8) | | 1279 (96.5) | | 1180 (89.0) | | 21 (1.6) | | 1286 (97.0) | | 1264 (95.3) | |

[a] Incorrect response.

**Table 4.**

Frequency and percentage of respondents who answered the question "What are some of the symptoms of a concussion?", by gender, age, race/ethnicity, and education.

| | Headache | Comparison statistic | Fever[a] | Comparison statistic | Changes in mood and/or behavior | Comparison statistic | Loss of sense of smell[a] | Comparison statistic | Problems with balance or dizziness | Comparison statistic | Sleep problems | Comparison statistic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total: frequency (percent) | 3826 (93.8) | | 448 (11.0) | | 2852 (70.0) | | 1131 (27.7) | | 3870 (94.9) | | 2175 (53.3) | |
| *Gender* | | $\chi^2(1)=8.03$, $p=0.005$ | | $\chi^2(1)=5.67$, $p=0.02$ | | $\chi^2(1)= 4.00$, $p=0.05$ | | $\chi^2(1)=6.37$, $p=0.01$ | | $\chi(1)= 4.69$, p=0.0304 | | $\chi(1)=2.57$, $p=0.11$ |
| Males | 1842 (92.75) | Cramer's $V=0.04$ | 242 (12.19) | Cramer's $V$—0.04 | 1360 (68.48) | Cramer's 0.031 | 587 (29.56) | Cramer's $V=0.04$ | 1870 (94.16) | Cramer's $V=0.03$ | 1085 (54.63) | |
| Females | 1984 (94.88) | | 206 (9.85) | | 1492 (71.35) | | 544 (26.02) | | 2000 (95.65) | | 1090 (52.13) | |
| *Age* | | $\chi^2(3)=10.84$, $p=0.0l$ | | $\chi^2(3) = 64.03$, $p<0.0001$ | | $\chi^2(3)=5.86$, $p=0.12$ | | $\chi^2(3)=12.61$, $p=0.006$ | | $\chi(3)=16–70$, $p=0.0008$ | | $\chi(3)=39.30$, $p<0.0001$ |
| 18–29 | 538 (92.12) | Cramer's $V=0.05$ | 105 (17.98) | Cramer's $V=0.13$ | 402 (68.84) | | 167 (28.60) | Cramer's $V=0.06$ | 542 (92.81) | Cramer's $V=0.06$ | 337 (57.71) | Cramer's $V=0.I0$ |
| 30–44 | 938 (92.41) | | 139 (13.69) | | 725 (71.43) | | 297 (29.26) | | 949 (93.50) | | 578 (56.95) | |
| 45–59 | 1243 (94.74) | | 130 (9.91) | | 937 (71.42) | | 389 (29.65) | | 1265 (96.42) | | 727 (55.41) | |
| 60 or older | 1107 (94.94) | | 74 (6.35) | | 788 (67.58) | | 278 (23.84) | | 1114 (95.54) | | 533 (45.71) | |
| *Race/ethnicity* | | $\chi^2(3)=42.48$, $p<0.0001$ | | $\chi^2(3)=2.07$, *p=0.56* | | $\chi^2(3)=37.56$, $p<0.0001$ | | $\chi^2(3)=7.55$, *6p*=0.06 | | $\chi(3)=55.01$, $p<0.0001$ | | $\chi(3)=46.49$, $p<0.0001$ |
| Non-Hispanic White | 2845 (95.31) | Cramer's $V=0.10$ | 316 (10.59) | | 2166 (72.56) | Cramer's $V=0.10$ | 850 (28.48) | | 2877 (96.38) | Cramer's $V=0.12$ | 1680 (56.28) | Cramer's $V=0.11$ |
| Non-Hispanic Black | 326 (89.32) | | 42 (11.51) | | 230 (63.01) | | 98 (26.85) | | 324 (88.77) | | 155 (42.47) | |
| Non-Hispanic Other | 210 (88.98) | | 30 (12.71) | | 155 (65.68) | | 71 (30.08) | | 219 (92.80) | | 126 (53.39) | |
| Hispanic | 445 (90.63) | | 60 (12.22) | | 301 (61.30) | | 112 (22.81) | | 450 (91.65) | | 214 (43.58) | |
| *Educational attainment* | | $\chi^2(2)=21.78$, $p<0.0001$ | | $\chi^2(2)=9.57$, $p=0.01$ | | $\chi^2(2)=75.60$, $p<0.0001$ | | $\chi^2(2)=67.71$, $p<0.0001$ | | $\chi(2)=31.53$, $p<0.0001$ | | $\chi(2)=101.40$, $p<0.0001$ |
| High school or less | 1410 (91.68) | Cramer's $V= 0.073$ | 141 (9.17) | Cramer's $V=0.05$ | 957 (62.22) | Cramer's $V=0.14$ | 315 (20.48) | Cramer's $V=0.13$ | 1423 (92.52) | Cramer's $V=0.09$ | 676 (43.95) | Cramer's $V=0.16$ |
| Some college | 1152 (94.50) | | 156 (12.80) | | 883 (72.44) | | 373 (30.60) | | 1167 (95.73 | | 673 (55.21) | |
| Bachelor's degree or higher | 1264 (95.76) | | 151 (11.44) | | 1012 (76.67) | | 443 (33.56) | | 1280 (96.97) | | 826 (62.58) | |

[a] Incorrect response.

**Table 5.**

Frequency and percentage of respondents who answered the question "What are some ways to prevent a concussion?" by gender, age, race/ethnicity, and education.[a]

| | Wear a helmet in sports and recreation | Comparison statistic | Reduce participation in contact sports | Comparison statistic | Wear a mouth guard during sports[b] | Comparison statistic | Wear seat-belts | Comparison statistic | Prevent falls | Comparison statistic | Install baby-gates across stairs | Comparison statistic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total: frequency (%) | 3338 (95.7) | | 2722 (78.1) | | 1050 (30.1) | | 3130 (89.8) | | 3106 (89.1) | | 2286 (65.6) | |
| *Gender* | | $\chi^2$(l)=0.78, *p*=0.38 | | $\chi^2$(l)=12.05, *p*=0.0005 | | $\chi^2$(l)=13.91, *p*=0.0002 | | $\chi^2$(I)=3.I0, *p*=0.08 | | $\chi^2$(l)=0.000, *p*=1.00 | | $\chi^2$(l)=15.26, *p*<0.0001 |
| Males | 1624 (95.4) | | 1371 (80.6) | Cramer's *V*—0.06 | 563 (33.1) | Cramer's *V*—0.06 | 1512 (88.8) | | 1516 (89.1) | | 1061 (62.3) | Cramer's *V*=0.07 |
| Females | 1714 (96.0) | | 1351 (75.7) | | 487 (27.3) | | 1618 (90.6) | | 1590 (89.1) | | 1225 (68.6) | |
| *Age* | | $\chi^2$(3)= 10.69, *p*=0.0l | | $\chi^2$(3)=9.78, *p=0.02* | | $\chi^2$(3)=25.98, *p*<0.0001 | | $\chi^2$(3)=17.86, *p*=0.0005 | | $\chi^2$(3)=9.67, *p*=0.02 | | $\chi^2$(3)=5.35, *p*=0.15 |
| 18–29 | 472 (93.1) | Cramer's *V*=0.06 | 376 (74.2) | Cramer's *V*=0.05 | 180 (35.5) | Cramer's *V*=0.09 | 433 (85.4) | Cramer's *V*=0.07 | 433 (85.4) | Cramer's *V*=0.05 | 320 (63.1) | |
| 30–44 | 829 (95.7) | | 660 (76.2) | | 285 (32.9) | | 766 (88.5) | | 772 (89.2) | | 584 (67.4) | |
| 45–59 | 1116 (96.5) | | 924 (79.9) | | 353 (30.5) | | 1056 (91.3) | | 1033 (89.3) | | 774 (66.9) | |
| 60 or older | 921 (96.2) | | 762 (79.6) | | 232 (24.2) | | 875 (91.4) | | 868 (90.7) | | 608 (63.5) | |
| *Race/ethnicity* | | $\chi^2$(3)=39.42, *p*<0.0001 | | $\chi^2$(3)=23.42, *p*<0.0001 | | $\chi^2$(3)=3.60, *p*=0.3 1 | | $\chi^2$(3)=71.64, *p*<0.0001 | | $\chi^2$(3)=36.41, *p*<0.0001 | | $\chi^2$(3)=54.96, *p*<0.0001 |
| Non-Hispanic White | 2526 (97.0) | Cramer's *V*=0.l 1 | 2083 (80.0) | Cramer's *V*—0.08 | 771 (29.6) | | 2402 (92.2) | Cramer's *V*=0.I4 | 2367 (90.9) | Cramer's *V*=0.I0 | 1794 (68.9) | Cramer's *V*=0.13 |
| Non-Hispanic Black | 262 (91.3) | | 211 (73.5) | | 100 (34.8) | | 228 (79.4) | | 237 (82.6) | | 151 (52.6) | |
| Non-Hispanic Other | 176 (92.2) | | 143 (74.9) | | 55 (28.8) | | 159 (83.3) | | 166 (86.9) | | 1 19 (62.3) | |
| Hispanic | 374 (92.6) | | 285 (70.5) | | 124 (30.7) | | 341 (84.4) | | 336 (83.2) | | 222 (55.0) | |
| *Educational attainment* | | $\chi^2$(2)=8.74, *p*=0.127 | | $\chi^2$(2)=49.85, *p*<0.0001 | | $\chi^2$(2)=10.49, *p*=0.005 | | $\chi^2$(2)=13.69, *p*=0.001 | | $\chi^2$(2)=23.94, *p*<0.0001 | | $\chi^2$(2)=32.14, *p*<0.0001 |
| High school or less | 1157 (94.4) | Cramer's *V*=0.05 | 890 (72.6) | Cramer's *V*=0.I2 | 330 (26.9) | Cramer's *V*=0.05 | 1072 (87.4) | Cramer's *V*=0.06 | 1056 (86.1) | Cramer's *V*=0.08 | 735 (60.0) | Cramer's *V=0.l0* |
| Some college | 1023 (96.2) | | 821 (77.2) | | 326 (30.7) | | 956 (89.9) | | 944 (88.8) | | 702 (66.0) | |
| Bachelors degree | 1158 (96.7) | | 1011 (84.4) | | 394 (32.9) | | 1102 (92.0) | | 1106 (92.3) | | 849 (70.9) | |

| | Wear a helmet in sports and recreation | Comparison statistic | Reduce participation in contact sports | Comparison statistic | Wear a mouth guard during sports[b] | Comparison statistic | Wear seat-belts | Comparison statistic | Prevent falls | Comparison statistic | Install baby-gates across stairs | Comparison statistic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| or higher | | | | | | | | | | | | |

[a] Only asked of those who answered “yes” or “sometimes” to “Can concussions be prevented?”

[b] Incorrect response.

**Table 6.**

Frequency and percentage of respondents who answered the question "What do you think are good sources of information about concussions?", by gender, age, race/ethnicity, and education.

| | Doctor or other health professional | Comparison statistic | Government resource such as the CDC and public health departments | Comparison statistic | TV, magazines, movies, or newspapers | Comparison statistic | Coach | Comparison statistic | Friends | Comparison statistic | Social media | Comparison Statistic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total: frequency (%) | 3870 (95.0) | | 2335 (57.3) | | 818 (20.1) | | 1208 (29.7) | | 518 (12.7) | | 436 (10.7) | |
| *Gender* | | $\chi^2$(l)=6.66, *p*=0.0I | | $\chi^2$(l)=1.12, *p*=0.29 | | $\chi^2$(l)=5.98, p=0.0l | | $\chi^2$(l)=12.55, *p*=0.0004 | | $\chi^2$(l)=0.54, *p*=0.46 | | $\chi^2$(l)=4.45, *p*=0.03 |
| Males | 1871 (94.1) | Cramer's *V*—0.04 | 1123 (56.5) | | 368 (18.5) | Cramer's *V*—0.04 | 538 (27.1) | Cramer's *V*=0.05 | 245 (12.3) | | 192 (9.7) | Cramer's *V*—0.03 |
| Females | 1999 (95.9) | | 1212 (58.1) | | 450 (21.6) | | 670 (32.1) | | 273 (13.1) | | 244 (1 1.7) | |
| *Age* | | $\chi^2$(3)=31.67, *p*<0.0001 | | $\chi^2$(3)=5.0I, *p*<0.17 | | $\chi^2$(3)=27.92, *p*<0.0001 | | $\chi^2$(3)=6.68, *p*=0.08 | | $\chi^2$(3)=5.I8, *p*=0.16 | | $\chi^2$(3)=12.96, *p*=0.005 |
| 18–29 | 533 (91.7) | Cramer's *V*—0.09 | 335 (57.7) | | 81 (13.9) | Cramer's *V*=0.08 | 155 (26.7) | | 72 (12.4) | | 45 (7.8) | Cramer's *V*—0.06 |
| 30–44 | 944 (93.4) | | 551 (54.5) | | 177 (17.5) | | 282 (27.9) | | 117 (1 1.6) | | 96 (9.5) | |
| 45–59 | 1258 (95.9) | | 775 (59.1) | | 289 (22.0) | | 414 (31.6) | | 159 (12.1) | | 144 (1 1.0) | |
| 60 or older | 1135 (97.1) | | 674 (57.7) | | 271 (23.2) | | 357 (30.5) | | 170 (14.5) | | 151 (12.9) | |
| *Race/ethnicity* | | $\chi^2$(3)=30.56, *p*<0.0001 | | $\chi^2$(3)=10.98, *p*=0.0l | | $\chi^2$(3) = 21.68, *p*<0.0001 | | $\chi^2$(3)=6.39, *p*=0.09 | | $\chi^2$(3)=9.04, *p*=0.03 | | $\chi^2$(3) = 24.45, *p*<0.0001 |
| Non-Hispanic White | 2864 (96.0) | Cramer's *V*—0.09 | 1732 (58.1) | Cramer's *V*=0.05 | 564 (18.9) | Cramer's *V*—0.07 | 883 (29.6) | | 351 (1 1.8) | Cramer's *V*=0.05 | 278 (9.3) | Cramer's *V*—0.08 |
| Non-Hispanic Black | 326 (90.1) | | 204 (56.4) | | 106 (29.3) | | 125 (34.5) | | 55 (15.2) | | 58 (16.0) | |
| Non-Hispanic Other | 222 (94.1) | | 147 (62.3) | | 47 (19.9) | | 69 (29.2) | | 37 (15.7) | | 36 (15.3) | |
| Hispanic | 458 (92.9) | | 252 (51.1) | | 101 (20.5) | | 131 (26.6) | | 75 (15.2) | | 64 (13.0) | |
| *Educational attainment* | | $\chi^2$(2)=10.92, *p*=0.004 | | $\chi^2$(2)=153.29, *p*<0.0001 | | $\chi^2$(2)=4.75, *p*=0.09 | | $\chi^2$(2)=6.45, *p*=0.04 | | $\chi^2$(2)=4.90, *p*=0.09 | | $\chi^2$(2)=M.82, *p*=0.003 |
| High school or less | 1438 (93.7) | Cramer's *V*=0.05 | 704 (45.9) | Cramer's *V*=0.I9 | 283 (18.5) | | 425 (27.7) | Cramer's *V*=0.04 | 205 (13.4) | | 177 (1 1.5) | Cramer's *V*—0.05 |

| | Doctor or other health professional | Comparison statistic | Government resource such as the CDC and public health departments | Comparison statistic | TV, magazines, movies, or newspapers | Comparison statistic | Coach | Comparison statistic | Friends | Comparison statistic | Social media | Comparison Statistic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Some college | 1159 (95.1) | | 725 (59.5) | | 265 (21.7) | | 392 (32.2) | | 167 (13.7) | | 149 (12.2) | |
| Bachelor's degree or higher | 1273 (96.4) | | 906 (68.6) | | 270 (20.5) | | 391 (29.6) | | 146 (ll.l) | | 110 (8.3) | |