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Comparison of self-reported lifetime concussions and mild traumatic brain injuries among adults

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Abstract

Introduction: The reliability of self-reported brain injury data relies on how well people interpret the questions.

Objective: This study examines how different yet commonly used questions may impact traumatic brain injury (TBI) estimates.

Methods: Self-report data were collected from 4,053 respondents in the summer wave of Porter Novelli's 2020 ConsumerStyles survey. Respondents were randomized to be asked about lifetime experience of either concussion or mild tBi (mTBI) and then asked follow-up questions.

Results: Approximately 25.5% of respondents reported sustaining a concussion in their lifetime while 17.2% reported an mTBI. The circumstances of the injuries, such as location and mechanism of injury, were similar. A greater percentage of individuals who were asked about concussions (91.1%) reported receiving a diagnosis for their most serious injury compared to those who were asked about diagnosis of an mTBI (69.9%).

Discussion: A greater percentage of respondents reported a lifetime history of concussion than mTBI. More respondents with a lifetime history of concussion reported receiving a diagnosis. These results suggest that the terminology used can impact reporting. These findings suggest that there is a meaningful difference in the understanding of the terms 'concussion' and 'mild TBI,' with people perceiving mTBI as a more serious injury.

Keywords

Concussion; traumatic brain injury; survey methodology

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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.

Introduction

Traumatic brain injury (TBI) is associated with millions of healthcare visits each year in the United States (1). Most of these injuries are mild injuries, categorized as mild traumatic brain injuries (mTBI) and concussions (2). Multiple efforts, ranging from advances in medical care and large-scale public health interventions to awareness campaigns and state policies, have been employed to reduce the burden of TBI, of all severity levels, among Americans (3,4). However, these efforts have been undertaken in the absence of comprehensive national incidence estimates that would allow for a better understanding of the true scope of the problem and the ability to determine the effectiveness of these efforts. To date, national TBI estimates have been derived from hospital or emergency department data (5) which typically exclude data for individuals seen by a primary care provider, in an urgent care clinic, or who did not receive any medical care. Thus, reliance on these current types of surveillance data to describe TBI in the United States has several limitations. These limitations likely result in a substantial undercount of this injury (6), especially for mTBI (often referred to as concussion), as many individuals do not seek ED care for a suspected mTBI (5).

Surveillance using participant self-report, through a national web or telephone-based survey, is a potential approach to obtaining more comprehensive TBI and concussion prevalence estimates (7,8). However optimal question wording that is well-understood by participants, and the use of standardized, validated questions, are critical to obtaining accurate self-report data. One of the most well-known measures to ascertain self-reported TBIs is the Ohio State University TBI Identification Method (OSU TBI-ID) (9). The OSU TBI-ID has been used to obtain population-based estimates of lifetime TBI by asking respondents a series of questions about an injury to the head or neck that resulted in the respondent being knocked out or losing consciousness (LOC), being dazed, or having a gap in their memory (9). However, a significant number of TBIs result in symptoms other than the three included in this measure and this may also lead to an undercount of TBIs.

Despite being a common neurological condition (2,10), researchers have debated for decades about the definition of concussion (11-13), with some even arguing to stop using the term all-together (14). Lack of agreement has led to the use of vague symptom-based criteria and inconsistent or conflicting terminology in the published literature, especially regarding concussion and mTBI (11,13,14). For example, some guidelines use the terms mTBI and concussion interchangeably (15,16), while others consider concussion as a subset of mTBI (11,17). Given longstanding definitional challenges related to TBI diagnosis/determination among clinicians and researchers, and the use of interchangeable terms, it is likely that the general public would also have uncertainty discerning what constitutes an mTBI or concussion. It is important to assess the impact of these uncertainties on self-report instruments if they are to be used to assess mTBI/concussion prevalence.

To this end, this study surveyed a sample of American adults to assess whether varying the use of terms (mild TBI vs. concussion) impacted the percentage of adults who self-reported having experienced either an mTBI or concussion in their lifetime. Differences in the

percentage of adults reporting a concussion (vs. mTBI) by demographic variables and in relation to injury circumstances (e.g., mechanism of injury) were also examined.

Materials and methods

Self-report data were collected from the summer wave ('SummerStyles') of Porter Novelli's 2020 ConsumerStyles survey (<http://styles.porternovelli.com>). SummerStyles is an annual web-based survey of U.S. adults aged 18 years or older that was fielded during June 2020. The survey was sent to a sample of 6,463 panelists. A total of 4,053 of these panelists completed the SummerStyles survey (62.7%). Respondents were drawn from the Ipsos KnowledgePanel[®] that gathers insights about U.S. consumers. Panel members were initially recruited using probability-based sampling of addresses. Respondents receive cash-equivalent reward points for their participation in these surveys which can be redeemed online for gift cards and prizes. Data were weighted to be nationally representative using Current Population Survey distributions based on sex, age, race and ethnicity, education, household income, household size, Census region, and metropolitan status. This study was exempt from institutional review board review because personal identifiers were not included. During recruitment, respondents were informed that their survey results are used for both market research and human research purposes. Respondents had the opportunity and freedom to opt out at any time and were permitted to refuse to answer any question. No personal identifiers are included in the data file that is provided to researchers. Access to the SummerStyles data was granted through a data-use agreement with Porter Novelli Public Services.

Measures

Respondents were randomly assigned to receive one of two questions:

1. A **concussion** can happen anytime a blow to the head causes you to have one or more symptoms, whether just for a short time or lasting a while. Symptoms include: blurred or double vision, being bothered by light or noise, headaches, dizziness or balance problems, nausea, vomiting, trouble sleeping, feeling tired, being dazed or confused, trouble remembering, trouble concentrating, or being knocked out. In your lifetime, do you believe that you have ever had a **concussion**?
2. A **mild traumatic brain injury** can happen anytime a blow to the head causes you to have one or more symptoms, whether just for a short time or lasting a while. Symptoms include: blurred or double vision, being bothered by light or noise, headaches, dizziness or balance problems, nausea, vomiting, trouble sleeping, feeling tired, being dazed or confused, trouble remembering, trouble concentrating, or being knocked out. In your lifetime, do you believe that you have ever had a **mild traumatic brain injury**?

Affirmative answers were classified as a self-reported concussion or mTBI. Respondents who self-reported a concussion or mTBI were then asked to indicate how many concussions or mTBIs they had sustained in their lifetime; where they were and what they were doing when they experienced their most serious concussion or mTBI; whether they were

checked by a doctor or nurse for their most serious concussion or mTBI, and if they had been medically checked, the type of clinical setting; whether they were diagnosed with a concussion or mTBI; and finally, which signs and symptoms they experienced. Response options for the symptom question included: blurred or double vision; headaches; bothered by light or noise; trouble sleeping, dizziness or balance problems; nausea; vomiting; feeling tired or fatigued; dazed or confused; trouble remembering; trouble concentrating; knocked out (lost consciousness); other symptom not listed; and no symptoms. Respondents were permitted to select multiple symptoms. However, if they selected 'no symptoms,' the other response choices were blocked. For each follow-up, respondents were randomized to either receive the words 'concussion' or 'mild traumatic brain injury,' depending on which words appeared in the first question. All of the survey questions can be found in the appendix.

Statistical analysis

Estimates and 95% confidence intervals (CIs) of lifetime prevalence of concussion or mTBI, number of lifetime injuries, location, and mechanism of injury (MOI), whether evaluation by a doctor or nurse was sought, where treatment was received, if diagnosis was given, and any symptoms experienced were calculated overall and stratified by type of question received (concussion vs. mTBI). Estimates were considered statistically significant if $p < 0.05$. Analyses were conducted using SAS version 9.4.

Results

Table 1 presents the demographic characteristics after weighting was applied. There was a nearly even split between men (48.4%) and women (51.6%). Approximately one in five (20.5%) were between the ages of 18–29, a quarter each were ages 30–44 (25.0%) and 45–59 (25.3%), and 29.2% were 60 years of age or older. The majority of individuals had at least some college education. About two-thirds (63.5%) of individuals identified as non-Hispanic White. More than one-third of individuals (38.0%) lived in the South, while 23.8% lived in the West, 20.7% in the Midwest, and 17.5% in the Northeast. A little over half (52.4%) had incomes of at least \$75,000 a year.

Overall, 21.3% of people self-reported sustaining a concussion or mild TBI in their lifetime (Table 2). A significantly higher percentage of people who received the 'concussion' question self-reported this injury (25.5%) than people who received the 'mTBI' question (17.2%). About half (53.2%) of individuals reported experiencing one concussion or mTBI in their lifetime; smaller percentages reported sustaining two (29.8%) or three or more (17.1%) injuries. There was no statistical difference among the reported number of concussions versus mTBIs reported. Approximately 37.0% of individuals reported sustaining their most serious injury while playing a sport or recreational activity, 20.9% while at home, and 15.3% while in a vehicle. About one in ten (10.8%) reported sustaining their most serious injury 'somewhere else;' additional location information was not collected. In terms of mechanism of injury, the most common response overall was by 'something else' (25.1%), followed by experiencing a trip, slip, or fall (21.9%), bumping their head on something (17.6%), or a car or motorcycle crash (16.1%). Neither the location of injury nor the MOI varied by which question was asked. A little over half

(53.7%) of the people reported being evaluated by a doctor or nurse after their most serious concussion or mTBI and about two-thirds (64.6%) received care at a hospital or emergency department. There was no statistical difference in location of concussion evaluation versus mTBI evaluation. Overall, about eight in ten (82.3%) received a diagnosis for their most serious injury. A significantly higher percentage of those who received the ‘concussion’ question reported being diagnosed with ‘concussion,’ (91.1%) compared to the percentage who received the ‘mTBI’ question (69.9%).

About half (52.2%) of all people reported experiencing three or more symptoms after their most serious injury. A variety of symptoms were reported, with headache being the most common (52.9%), followed by being dazed or confused (38.2%), dizziness or balance problems (38.1%), and being knocked out/losing consciousness (31.3%). There were some differences in symptom reporting based on whether the question pertained to a concussion or mTBI; a higher percentage of individuals who received the ‘concussion’ question (24.9%) were bothered by light or noise after their most serious injury compared to those who received the ‘mTBI’ question (17.9%). Conversely, a higher percentage of those who received the ‘mTBI’ question (9.2%) reported sadness after their injury compared to those who received the ‘concussion’ question (4.1%). Finally, those who responded to the mTBI question were also more likely to report experiencing ‘another symptom not listed’ (9.9%) compared to those who responded to the ‘concussion’ question (4.7%).

Discussion

This study found that about one in five adults reported a lifetime history of concussion or mTBI. Asking about a lifetime history of concussion elicited more affirmative responses, even though an identical definition was provided for both concussion and mTBI. Despite this difference, the circumstances of how (mechanism of injury) and where (e.g., at home, in a vehicle) a respondent sustained a concussion/mTBI were not statistically different. Aside from a few differences, the symptoms reported were generally similar for both terms. Taken together, this suggests that the injuries that were experienced but not reported in the mTBI condition, relative to the concussion condition, may not be substantively different. However, these findings do suggest that there may be a meaningful difference in the public’s understanding of the terms ‘concussion’ and ‘mild traumatic brain injury,’ with mild traumatic brain injury potentially being understood as a more serious injury.

Recent studies examining concussion question wording experiments found that the provision of a concussion definition, with either a long symptom list, short symptom list, or no definition, did not impact concussion self-reporting (7). In contrast, the main finding of this study – that a higher percentage of people reported having had a concussion compared to reporting having had an mTBI – suggests that the terminology used (concussion vs. mTBI) can have a meaningful impact on self-reporting, even though a common definition was provided. If the term ‘mTBI’ is used in self-report surveys, a lower prevalence will likely be found. Future research might reexamine the impact of using varying terminology, but without the inclusion of a definition as part of the question.

Recent studies point to a marked increase in concussion diagnosis among Americans, due in some part to more people seeking care for head injuries (18). Some studies hypothesize that the growth in medical visits for concussion are associated with greater awareness of this injury, public health interventions and policies, and/or changes in diagnostic criteria (19,20). Currie and colleagues analyzed surveillance data of concussions among high school athletes and found a decrease in the proportion of concussions with what have traditionally been considered severe symptoms (LOC, amnesia) and the increase in what were traditionally considered minor symptoms (drowsiness, irritability, light and noise sensitivity) (19). The authors suggest these findings may indicate that healthcare providers are employing a lower threshold in diagnosing concussions in more recent years (19). Further, Mayer and colleagues reviewed more recent diagnostic criteria for concussion and suggested that some organizations have shifted to classifying concussion as a less severe form of mTBI (13). Taken together, these factors may help explain why more respondents indicated they had a concussion versus a mTBI. However, an analysis of contributing factors that led to a higher percentage of lifetime concussions among respondents was not possible in this study. Future efforts to explore this further may be beneficial. For example, it is important to determine if members of the general public consider concussion and mTBI to be distinct injuries. The results of this study suggest that some people do view them differently and that mild TBI conveys a more serious injury.

Healthcare providers may prefer the term concussion over mTBI as it is considered less likely to elicit fear and is perceived to have better health outcomes than mTBI (21,22). Further, due to the proliferation of protocols focused on returning to school and sports after a concussion, some healthcare providers may use the term concussion with the idea of linking a patient's diagnosis to these interventions. However, how healthcare providers classify a patient's injury (for example, concussion versus mTBI versus head injury) may affect their clinical care and outcomes (21). In a study of 300 pediatric patients who were admitted to a hospital with a diagnosis of TBI, DeMatteo and colleagues were interested in predicting the use of the concussion label by physicians (21). A concussion was scored as being present if the child's healthcare providers made any mention of a concussion on their medical chart. They found that pediatric patients who were admitted to the hospital with a diagnosis of TBI and were subsequently labeled as having a concussion were more likely to be discharged early and more quickly returned to school than those without the concussion label, independent of their Glasgow Coma Score and the presence of other associated injuries (21). This same study found that children with more severe TBIs (beyond what would typically be considered to be mild TBIs) may also be diagnosed by their healthcare provider with a 'concussion,' indicating wide variability in the application of the term (21). More research is needed to determine which term providers prefer and if their usage of terms varies based on characteristics of the injury (e.g., mechanism of injury) or the patient (e.g., education level, age).

The term that healthcare providers use in their clinical interactions with injured patients may also impact surveillance estimates. Our study found that more individuals who were given the term 'concussion' on the survey reported that their healthcare provider diagnosed them with that particular injury than individuals who were given the term 'mTBI.' It is possible that a substantial proportion of persons given the term 'mTBI' on the survey were

told they had sustained a concussion by their healthcare provider, thus contributing to this discrepancy, but not meaningfully changing their treatment outcomes. While researchers may consider the terms concussion and mTBI to be interchangeable, members of the general public may not, which may contribute to under-reporting of ‘traumatic brain injury’ on self-report surveys. Additionally, future studies that explore the impact of terminology used during patient diagnosis and discharge may shed light on how surveillance efforts can be improved to better align with patient experiences and knowledge.

Limitations

A limitation of this study is that SummerStyles data are self-reported and may be subject to bias. Recall bias may occur when a respondent is referencing a concussion that was sustained many years ago. Additionally, SummerStyles is a web-based panel survey and may not be fully representative of the U.S. adult population. However, the data are weighted to be nationally representative. Furthermore, the survey questions used in the study to identify self-reported concussions have not been validated and affirmative responses were not validated by independent medical diagnosis.

Conclusion

A greater percentage of respondents in this study reported a lifetime history of concussion than a lifetime history of mTBI. While the mechanism of injury and where respondents sustained a concussion or mTBI were similar, more respondents with a lifetime history of concussion reported receiving a diagnosis. To our knowledge, this is the first study to quantify differences in prevalence rates for lifetime concussion and mTBI. Greater familiarity with the term concussion among the public, differing perceptions of injury severity, and inconsistent terminology used by healthcare providers are some potential explanations for the findings in this study. However, this analysis is not able to assess whether these factors are the key contributors or if others play a stronger role. Future studies that explore these questions may be beneficial.

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Appendix: 2020 Porter Novelli SummerStyles Survey Questions on Concussion and Mild Traumatic Brain Injury

All respondents

1a. A concussion can happen anytime a blow to the head causes you to have one or more symptoms, whether just for a short time or lasting a while. Symptoms include: blurred or double vision, being bothered by light or noise, headaches, dizziness or balance problems, nausea, vomiting, trouble sleeping, feeling tired, being dazed or confused, trouble remembering, trouble concentrating, or being knocked out. In your life-time, do you believe that you have ever had a concussion?

Select one.

1. Yes
2. No

All respondents

1b. A mild traumatic brain injury can happen anytime a blow to the head causes you to have one or more symptoms, whether just for a short time or lasting a while. Symptoms include: blurred or double vision, being bothered by light or noise, headaches, dizziness or balance problems, nausea, vomiting, trouble sleeping, feeling tired, being dazed or confused, trouble remembering, trouble concentrating, or being knocked out. In your lifetime, do you believe that you have ever had a mild traumatic brain injury?

Select one.

1. Yes
2. No

PROGRAMMER CREATE TEXT INSERT TO SHOW [inserted text] BASED ON WHETHER CON1A = 1 OR CON1B = 1.

ASK IF 1A = 1 OR 1B = 1

2. How many [concussions/mild traumatic brain injuries] have you had in your lifetime?

ASK IF 1A = 1 OR 1B = 1

3. Thinking back to when you had your most serious [concussion/mild traumatic brain injury], were you ... ?

Select one.

1. At work or volunteering
2. Playing a sport or recreational activity
3. At home
4. In a public place (sidewalk, store, restaurant, etc.)
5. In a vehicle (car, bus, train, etc.)
6. Somewhere else

ASK IF 1A = 1 OR 1B = 1

4. When you got your most serious [concussion/mild traumatic brain injury], which item below best matches how you got hurt?

Select one.

1. A car or motorcycle crash

2. Fell or crashed on a bicycle
3. Tripped, slipped, or fell and hit my head
4. I got hit in the head during a fight or an argument
5. Ran into another person by accident
6. Bumped my head on something
7. Felt dizzy or sick and fell, or passed out
8. Doing something else

ASK IF 1A = 1 OR 1B = 1

5. Did a doctor or nurse check you for your most serious [concussion/mild traumatic brain injury]?

Select one.

1. Yes
2. No

ASK IF 5 = 1

6. Where did the doctor or nurse first check you for your most serious [concussion/mild traumatic brain injury]?

Select one.

1. At your regular doctor's office
2. At a hospital or emergency department
3. At an urgent care clinic
4. At a sports medicine or concussion clinic
5. Someplace else

ASK IF 5 = 1

7. Did the doctor or nurse diagnose you with a [concussion/ mild traumatic brain injury]?

Select one.

1. Yes
2. No

ASK IF 1A = 1 OR 1B = 1

8. Did you experience any of the following symptoms after your most serious [concussion/ mild traumatic brain injury]?

Select all that apply.

1. Blurred or double vision
2. Headaches
3. Bothered by light or noise
4. Problems with sleep
5. Dizziness or balance problems
6. Nausea or vomiting
7. Feeling tired or fatigued
8. Dazed or confused
9. Trouble remembering or concentrating
10. Knocked out (lost consciousness)
11. Feeling angry
12. Feeling sad
13. Other symptom not listed
14. I experienced no symptoms

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Table 1.

Characteristics of Respondents in 2020 Porter Novelli SummerStyles Sample, n = 4,047, United States.*

Characteristic	Frequency	Weighted Frequency	Percent
<i>Sex</i>			
Male	2,039	1,956	48.4
Female	2,008	2,089	51.6
Total	4,047	4,045	100.0
<i>Age</i>			
18–29	364	829	20.5
30–44	987	1,012	25.0
45–59	1,225	1,025	25.3
60 or over	1,471	1,180	29.2
Total	4,047	4,045	100.0
<i>Education</i>			
HS grad or less	1,278	1,568	38.8
Some college	1,129	1,118	27.6
Bachelor's degree or higher	1,640	1,360	33.6
Total	4,047	4,045	100.0
<i>Race/Ethnicity</i>			
Non-Hispanic White	2,971	2,568	63.5
Non-Hispanic Black	328	472	11.7
Hispanic	331	350	8.6
Non-Hispanic Other	417	655	16.2
Total	4,047	4,045	100.0
<i>U.S. Region</i>			
Northeast	737	708	17.5
Midwest	903	839	20.7
South	1,441	1,535	38.0
West	966	962	23.8
Total	4,047	4,045	100.0
<i>Income</i>			

Characteristic	Frequency	Weighted Frequency	Percent
<\$25,000	404	540	13.3
\$25,000-\$74,999	1,343	1,387	34.3
\$75,000	2,300	2,118	52.4
Total	4,047	4,045	100.0

* All estimates are weighted except sample sizes (n).

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Table 2.

Lifetime concussion and mild traumatic brain injury (mTBI) prevalence, number, location of injury, mechanism of injury, and whether evaluated by a healthcare professional by question type, 2020 Porter Novelli SummerStyles.

	Total				Concussion ¹				Mild TBI ²				p-value	
	Frequency	Weighted Frequency	%	95% C.I.	Frequency	Weighted Frequency	%	95% C.I.	Frequency	Weighted Frequency	%	95% C.I.		X ²
Yes, I have had a concussion/mTBI	914	862	21.3	(19.8,22.8)	543	508	25.5	(23.2,27.8)	371	354	17.2	(15.2,19.2)	41.7	<0.0001
No, I have not	3,133	3184	78.7	(77.2,80.2)	1,441	1482	74.5	(72.2,77.0)	1,692	1701	82.8	(80.8,84.8)		
Number of lifetime concussions/TBIs ^c													0.5	0.85
1	454	434	53.2	(49.1,57.2)	276	262	53.6	(48.3,58.8)	178	172	52.5	(46.2,58.8)		
2	260	243	29.8	(26.1,33.5)	154	147	30.1	(25.1,35.0)	106	96	29.4	(23.8,35.0)		
3+	157	139	17.1	(14.2,19.9)	92	80	16.4	(12.8,19.9)	65	59	18.1	(13.5,22.7)		
Location of most serious injury ^c													14.5	0.07
At work or volunteering	69	60	7.0	(5.1,8.9)	37	32	6.3	(3.9,8.6)	32	28	8.0	(4.9,11.1)		
Playing a sport or recreational activity	342	319	37.0	(33.1,40.9)	219	211	41.5	(36.3,46.7)	123	108	30.6	(25.0,36.2)		
At home	176	180	20.9	(17.4,24.3)	97	92	18.1	(14.1,22.1)	79	88	24.9	(18.9,30.8)		
In a public place	81	79	9.0	(6.8,11.2)	46	43	8.4	(5.7,11.1)	35	35	10.0	(6.3,13.6)		
In a vehicle	149	132	15.3	(12.6,17.9)	85	73	14.4	(11.1,17.7)	64	58	16.5	(12.2,20.9)		
Somewhere else	96	93	10.8	(8.3,13.2)	59	57	11.3	(8.0,14.5)	37	36	10.1	(6.4,13.7)		
Mechanism of injury for most serious concussion/TBIs ^c													4.7	0.87
A car or motorcycle crash	153	139	16.1	(13.3,19.0)	87	78	15.3	(11.8,18.9)	66	61	17.3	(12.6,21.9)		
Fell or crashed on a bicycle	54	44	5.2	(3.6,6.8)	28	25	5.0	(2.8,7.2)	26	19	5.4	(3.1,7.8)		
Tripped, slipped, or fell and hit my head	194	188	21.9	(18.5,25.2)	118	114	22.5	(18.1,27.0)	76	74	20.9	(15.8,26.0)		
Hit in the head during a fight or an argument	49	57	6.7	(4.5,8.8)	32	36	7.1	(4.4,9.7)	17	21	6.1	(2.5,9.7)		
Ran into another person by accident	44	40	4.7	(3.1,6.2)	23	21	4.2	(2.3,6.1)	21	19	5.3	(2.6,8.0)		

	Total			Concussion ¹			Mild TBI ²			p-value
	Frequency	Weighted Frequency	95% C.I.	Frequency	Weighted Frequency	95% C.I.	Frequency	Weighted Frequency	95% C.I.	
Bumped my head on something	155	151	17.6 (14.5,20.7)	101	93	18.5 (14.4,22.5)	54	58	16.4 (11.5,21.2)	
Felt dizzy or sick and fell, or passed out	26	24	2.8 (1.6,4.0)	10	11	2.1 (0.6,3.6)	16	13	3.8 (1.8,5.8)	
Something else	234	215	25.1 (21.6,28.6)	141	128	25.3 (20.7,29.9)	93	87	24.8 (19.4,30.2)	0.1
Did a doctor or nurse evaluate you for your most serious concussion/TBI? ^c										0.76
Yes	494	461	53.7 (49.7,57.7)	287	269	53.2 (48.0,58.4)	207	192	54.5 (48.2,60.7)	
No	417	397	46.3 (42.3,50.3)	254	237	46.8 (41.6,52.0)	163	161	45.5 (39.3,51.8)	
Where did the doctor or nurse first evaluate your most serious concussion/TBI? ^d										9.7
At regular doctor's office	94	89	19.3 (14.7,23.9)	53	47	17.3 (11.9,22.8)	41	42	22.0 (14.1,29.8)	
At a hospital or emergency department	324	298	64.6 (59.2,69.9)	186	172	64.0 (56.9,71.0)	138	126	65.4 (57.2,73.7)	
At an urgent care clinic	31	35	7.5 (4.6,10.4)	17	19	7.2 (3.3,11.2)	14	15	7.9 (3.6,12.2)	
At a sports medicine or concussion clinic	13	17	3.7 (1.0,6.3)	10	15	5.7 (1.3,10.1)	3	2	0.9 (0.0,2.1)	
Someplace else	32	23	5.0 (3.0,6.9)	21	16	5.8 (3.0,8.6)	11	7	3.8 (1.4,6.2)	36.7 <0.0001
Did the doctor or nurse diagnose you with a concussion or mTBI? ^e										
Yes	405	379	82.3 (78.2,86.3)	259	245	91.1 (87.4,94.7)	146	134	69.9 (62.2,77.6)	
No	86	82	17.7 (13.7,21.8)	27	24	8.9 (5.3,12.6)	59	58	30.1 (22.4,37.8)	
Number of symptoms ^c										6.5
0	102	96	11.2 (8.7,13.7)	71	65	13.1 (9.7,16.4)	31	30	8.6 (4.9,12.3)	0.24
1	153	148	17.4 (14.2,20.6)	88	78	15.6 (11.9,19.4)	65	69	19.9 (14.4,25.4)	
2	184	163	19.2 (16.1,22.2)	117	93	18.5 (14.9,22.1)	67	70	20.1 (14.9,35.4)	
3+	464	444	52.2 (48.2,56.2)	261	264	52.8 (47.6,57.9)	203	179	51.4 (45.1,57.7)	
Symptoms ^c										
Headache	464	450	52.9 (48.9,56.9)	267	262	52.2 (47.1,57.4)	197	188	53.9 (47.6,60.1)	0.3
Dazed or confused	349	324	38.2 (34.3,42.0)	208	190	38.0 (32.9,43.0)	141	134	38.4 (32.4,44.4)	0.0
Dizziness or balance problems	339	324	38.1 (34.2,42.0)	183	184	36.7 (31.6,41.8)	156	140	40.0 (33.9,46.1)	1.0

	Total			Concussion ^a			Mild TBI ^b							
	Frequency	Weighted Frequency	%	95% C.I.	Frequency	Weighted Frequency	%	95% C.I.	X ²	p-value				
Knocked out/loss of consciousness	296	266	31.3	(27.7,34.9)	160	143	28.6	(24.0,33.2)	136	123	35.1	(29.4,40.9)	4.4	0.08
Feeling tired or fatigued	259	262	30.8	(27.1,34.6)	153	162	32.3	(27.3,37.4)	106	100	28.7	(23.1,34.4)	1.3	3.50
Bothered by light or noise	170	187	22.0	(18.4,25.6)	102	125	24.9	(19.8,30.0)	68	62	17.9	(13.1,22.6)	6.3	0.05
Blurred or double vision	188	188	22.2	(18.6,25.7)	107	113	22.5	(17.7,27.3)	81	76	21.7	(16.6,26.7)	0.1	0.82
Trouble remembering or concentrating	194	184	21.7	(18.4,25.0)	98	96	19.1	(14.9,23.3)	96	89	25.4	(20.1,30.7)	5.2	0.06
Nausea or vomiting	180	180	21.2	(17.9,24.5)	107	114	22.7	(18.1,27.3)	73	67	19.1	(14.5,23.7)	1.7	0.28
Trouble sleeping	87	93	11.0	(8.2,13.7)	48	53	10.7	(7.1,14.3)	39	40	11.4	(7.2,15.5)	0.1	0.80
Angry	61	67	7.8	(5.5,10.1)	31	35	7.1	(4.2,10.0)	30	31	9.0	(5.2,12.7)	1.1	0.43
Sad	47	53	6.2	(4.1,8.3)	19	21	4.1	(2.0,6.3)	28	32	9.2	(5.2,13.1)	9.6	0.02
Other symptom not listed	64	58	6.8	(4.9,8.8)	28	23	4.7	(2.4,7.0)	36	35	9.9	(6.4,13.4)	9.4	0.01
No symptoms	102	95	11.2	(8.7,13.7)	71	65	13.1	(9.7,16.4)	31	30	8.6	(4.9,12.3)	4.4	0.09

^aA concussion can happen anytime a blow to the head causes you to have one or more symptoms, whether just for a short time or lasting a while. Symptoms include: blurred or double vision, being bothered by light or noise, headaches, dizziness or balance problems, nausea, vomiting, trouble sleeping, feeling tired, being dazed or confused, trouble remembering, trouble concentrating, or being knocked out. In your lifetime, do you believe that you have ever had a concussion?

^bA mild traumatic brain injury can happen anytime a blow to the head causes you to have one or more symptoms, whether just for a short time or lasting a while. Symptoms include: blurred or double vision, being bothered by light or noise, headaches, dizziness or balance problems, nausea, vomiting, trouble sleeping, feeling tired, being dazed or confused, trouble remembering, trouble concentrating, or being knocked out. In your lifetime, do you believe that you have ever had a mild traumatic brain injury?

^cFor those respondents who answered 'yes' to any of the concussion prevalence questions

^dFor those respondents who indicated a doctor or nurse evaluated them for their most serious concussion/TBI

Note: Percentages may not add to 100% due to rounding