HHS Public Access

Author manuscript

Ann Epidemiol. Author manuscript; available in PMC 2021 May 27.

Published in final edited form as:

Ann Epidemiol. 2021 February ; 54: 11–20. doi:10.1016/j.annepidem.2020.11.006.

Comparing prevalence estimates of concussion/head injury in U.S. children and adolescents in national surveys

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Abstract

Background and objectives: Reports on pediatric lifetime concussions/head injuries (LCHI) from national surveys have offered estimates on prevalence that range from 2.5% to 18% in the general population. The purpose of this study is to examine national surveys to compare methodologies and limitations pertaining to LCHI data collection.

Methods: Three nationally representative surveys that measure LCHI in children, including the National Survey of Children's Health, the National Health Interview Survey, and the Monitoring the Future Survey were examined. Children were grouped by ages 3–17 years and adolescent ages 13–17 years, stratified by selected demographic characteristics. Participants in the surveys included parents (NSCH and NHIS) and adolescents (MTF survey). The primary outcome measure is an estimate of LCHI in children.

Results: Estimates of prevalence of LCHI ranged from 3.6% to 7.0% for children ages 3–17 years and from 6.5% to 18.3% for adolescents 13–17 years. Survey modality, question wording, and respondent may contribute to differing estimates. Prevalence showed consistent variation by age, sex, and race/ethnicity across surveys. Associations were inconsistent between LCHI and insurance status, parental education, and household primary language.

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Conclusions: Although there are methodological differences in capturing pediatric LCHI across surveys, the prevalence estimates and correlational associations generated can offer awareness about the burden of these injuries and insights to research and clinical care.

Introduction

Traumatic Brain Injury (TBI) in children living in the United States is a significant public health problem as indicated by the high rate of emergency department visits for this population [1] and the complex sequelae that can follow [2]. In addition to the emergency department, children who have experienced a TBI can receive medical care in a variety of clinical locations, including pediatrician offices, urgent care, and specialty care clinics. However, national estimates of TBI prevalence, which use administrative health care databases based on hospital records, do not include care received in these other settings [1,3]. Particularly for mild injuries, parents may choose not to seek care [2,4] or may have difficulty accessing care due to the availability of providers, lack of insurance coverage, and lack of access to transportation [5–7]. These factors may result in significant underestimates of national pediatric TBI incidence. One approach to more comprehensively quantify the burden of TBI in children is to use surveys that collect self- or proxy-reported information.

Previous reports from national surveys offered estimates on lifetime prevalence of concussive head injuries in the general population that range from 2.5% to 7.0% among children 17 years and under and from 5.9% to 18.4% when limiting analyses to adolescents 13 years and over [4,8,9]. Even after accounting for different age groups underlying these estimates, the considerable variation may be due to differences in the survey respondent (parent proxy or child self-report), question wording (whether using a broad term such as head injury, previous diagnosis of concussion, or TBI by a health care professional), or mode of survey administration (in-person interview, telephone, paper, tablet, or web-based survey) [10]. These methodological differences and potential contribution to the variations in estimates have not previously been examined in detail. The purpose of this study was four-fold. First, to describe the methodology of three national surveys that included a pediatric concussion/head injury question. Second, compare prevalence estimates of lifetime pediatric concussion/head injury across surveys. Third, assess whether associations between pediatric concussion or head injury and demographic characteristics differed across surveys. Fourth, discuss how differences in methodology across surveys may have contributed to differences in estimates and associations between pediatric concussion/head injury and demographic characteristics.

Methods

Data sources

The present study examined national surveys that measure lifetime history of concussion or head injury among children, including the National Survey of Children's Health (NSCH) [11], the National Health Interview Survey (NHIS) [12], and the Monitoring the Future (MTF) survey [13]. The methodological parameters varied across surveys, including sample size, mode of administration, responder, sampling frame, response rates, and differences in question wording (Table 1). Notably, the NSCH and NHIS consist of address-based parent

report samples targeting noninstitutionalized children 0–17 years, whereas the MTF consists of a school-based self-report sample targeting eighth, 10th, and 12th grade students. Although all surveys are conducted annually, not all surveys ask about concussion/head injury every year. Therefore, the analyses were limited to 2016 data, the most recent year for which all three surveys collected concussion/head injury information.

Statistical analysis

To increase comparability of results across data sources, separate analyses for two age groups were conducted: (1) children ages 3–17 years (comparing NSCH and NHIS) and (2) adolescent ages 13–17 years (comparing NSCH, NHIS, and MTF). For each national survey and age group, distributions of selected demographic characteristics were obtained, including child age, sex, race/ethnicity, current health insurance, household income (imputed when missing), parents' highest educational attainment, and household primary language (either asked as a question (NSCH and MTF) or based on the language the survey was conducted in (NHIS). MTF did not include measures for current health insurance or household income.

For each of the three surveys, unadjusted lifetime prevalence estimates and population frequencies of lifetime concussion/head injury were calculated based on the surveys' respective questionnaire items, and bivariate analyses were conducted to determine prevalence of concussion/head injury by demographic characteristics. Respondents with missing values for concussion/head injury information were excluded from these analyses. Chi-square tests of independence with design-based F statistics were conducted to assess the overall associations between lifetime concussion/head injury and variables of interest. Relationships between concussion/head injury and demographic variables were examined in each survey to determine whether the direction, magnitude, and statistical significance of associations were consistent across surveys. Finally, multiple logistic regression analysis was conducted to examine adjusted associations between lifetime concussion/head injury and demographic characteristics and to determine whether associations were stable across all surveys. For models pertaining to adolescents, only variables available across all surveys were included as covariates (health insurance and household income were excluded because they were not available in the MTF survey). Model results are reported as adjusted prevalence rate ratios (aPRRs) and 95% confidence intervals comparing the effect of each covariate on the relative prevalence of lifetime history of concussion/head injury while keeping all other covariates constant. Analysis incorporated each survey's respective weights and design variables needed to weight each survey's study sample to reflect a nationally representative sample of U.S. children and account for the complex survey design. NSCH and MTF analyses were conducted using Stata SE version 15. The NHIS analysis was conducted using SUDAAN version 11.0 software.

Results

Differences in survey methodology and sample characteristics

Surveys differed on all methodological parameters evaluated (Table 1). In particular, the NSCH and NHIS data were collected from parents/caregivers on behalf of their children,

whereas the MTF data were self-reported by middle- and high-school youth. In addition, the NSCH was conducted via Web or paper questionnaire, the NHIS was conducted through in-person interviews, and the MTF was administered by paper questionnaire only. Finally, the NSCH asked about whether "a doctor or other health care provider ever told you that this child has….brain injury, concussion, or head injury," whereas the NHIS asked if the child "ever had a significant head injury or concussion," and the MTF asked if the child had "ever had a head injury that was diagnosed as a concussion." Although each survey used different terminology and varied in diagnosis questions, the general term "lifetime concussion/head injury" (LCHI) shall be used from this point forward to describe the primary outcome variable.

Sample sizes ranged from 9247 children ages 3–17 in the NHIS (3392 were 13–17 years) to 43,283 children ages 3–17 years in the NSCH (17,783 were 13–17 years); 10,985 children ages 13–17 years were included from the MTF. Among the two national surveys that included children ages 3–17 years (NSCH and NHIS), distribution of demographics produced from weighted analysis were similar, although there were some different distributions for insurance status, parental education attainment, and household language (Table 2). For the population of adolescents aged 13–17 years in all surveys, there were several demographic differences across surveys.

Concussion/head injury prevalence and demographic correlates among children, 3–17 years

The prevalence of LCHI among children aged 3–17 years varied across the NSCH and NHIS (Table 3). Specifically, the NSCH found that 3.6% (95% CI: 3.3, 3.9) of children had ever sustained a LCHI while the NHIS estimate was nearly double at 7.0% (95% CI: 6.4, 7.7).

Prevalence of LCHI also varied significantly by demographics in both surveys in consistent ways (Table 3). For example, in both the NSCH and the NHIS, LCHI among children was associated with increasing age ($p < 0.0001$), male sex (p ¼ 0.0001), and non-Hispanic white race/ethnicity ($p < 0.0001$). Current health insurance status, household income, parental education, and household primary language had similar relationships with LCHI in the two surveys but did not always reach statistical significance.

The aPRRs for LCHI among children aged 3–17 years in the NSCH and NHIS are presented in Table 4. After controlling for other demographic variables, increasing age was associated with increased prevalence of LCHI for both the NSCH and NHIS. In the NSCH, compared with children age 3–5 years, those in all older age groups had increased prevalence of LCHI (aPRR range = 1.81–5.67). In the NHIS, there were no significant differences between the two youngest age groups, but those in the three oldest age groups had significantly increased prevalence than those aged 3–5 years (aPRR range = 1.50–3.19). Both surveys also found that girls had a 31% decreased prevalence of LCHI compared with boys. In addition, both surveys found that Hispanic, non-Hispanic black, and non-Hispanic other race children had significantly lower prevalence than non-Hispanic white children (aPRR range = 0.49–0.66). Neither survey found household income was significantly associated with the LCHI after adjustment.

The results differed across the two surveys in relation to other demographic factors. After adjustment, the prevalence of LCHI did not vary by insurance status using the NSCH; however, within the NHIS prevalence of LCHI among uninsured children was about 60% higher than among those with private insurance (aPRR = 1.58, 95% CI: 1.02–2.44). In addition, in the NSCH children whose parents had a high school education had 32% lower prevalence of LCHI than children whose parents had a college degree or higher (aPRR = 0.68, 95% CI: 0.49–0.88). No such association was found in the NHIS. Finally, using the NSCH, children from households where English was not the primary language had 68% lower prevalence of LCHI than those from households where English was the primary language (aPRR = 0.32, 95% CI: 0.14–0.49); no such association was found in the NHIS.

Concussion/head injury prevalence and demographic correlates among adolescents, 13–17 years

The prevalence of LCHI among adolescents aged 13–17 years varied across all surveys (Table 5). In general, the NHIS estimates were higher than NSCH estimates and MTF estimates were significantly higher than both. Specifically, the NSCH found that 6.5% (95% CI: 5.9, 7.1) of adolescents 13–17 years had ever sustained a LCHI; NHIS reported lifetime prevalence to be 10.2% (95% CI: 9.0, 11.6), and the MTF reported lifetime prevalence to be 18.3% (95% CI: 17.2, 19.3).

The prevalence of LCHI also varied by demographic characteristics for adolescents aged 13–17 years (Table 5). However, not all surveys produced the same associations. Both NHIS and MTF found that older age ($p = 0.0061$ and 0.0132, respectively) and male sex ($p = 0.0022$ and < 0.0001, respectively) were significantly associated with higher prevalence of LCHI, than younger age and female sex, respectively, but the NSCH did not find such significant associations. Similarly, the NSCH found significant differences in lifetime concussion/head injury by current health insurance status and household income, but the NHIS did not find the same associations.

Table 6 shows results of multiple logistic regression models for adolescents aged 13–17 years using five demographic variables available in all surveys (age, sex, race/ethnicity, parental education attainment, and household primary language). The direction of association was generally similar across surveys, with a few key differences. After controlling for other demographic factors, all surveys found a decreased prevalence of LCHI among girls compared with boys (aPRR range = 0.60–0.79). In addition, all surveys found a decreased prevalence among Hispanic (aPRR range = 0.46–0.68) and non-Hispanic “other” race (aPRR range = 0.38–0.82) adolescents, compared with non-Hispanic white adolescents; the NSCH and the MTF also found decreased prevalence among non-Hispanic black adolescents (aPRR range = 0.46–0.61). Both the NHIS and MTF found that adolescents aged 16–17 years had an increased prevalence relative to those aged 13–15 years (aPRR range = 1.18–1.47), however, no age association was found using the NSCH. There was no consistent relationship between parental education and LCHI prevalence across the surveys for adolescents, after controlling for other demographic factors. While the NHIS and MTF found no relationship between household language and LCHI prevalence, the NSCH found

that prevalence was substantially lower among adolescents from non–English-speaking households, relative to adolescents from English-speaking households.

Discussion

This is the first study to examine three nationally representative U.S. surveys to provide recent prevalence estimates for LCHI among children. Overall estimates ranged from 3.6% to 7.0% for children aged 3–17 years and from 6.5% to 18.3% for adolescents 13–17 years. Each survey had a large and nationally representative sample. Differences in sample size may have impacted the precision of the estimates. It is unknown how the differing sampling structures may have impacted differences in the prevalences found in the NSCH, NHIS, and MTF. It is possible that sampling strategies in the NSCH and NHIS (address-based samples) resulted in lower response rates and selection bias than the MTF (school-based sample), however, all surveys were based on nationally representative sampling frames and used sampling weights to adjust for nonresponse and other factors.

The different prevalence estimates produced by the surveys may be due to differences in survey modality, question wording, and reporting source. Address-based surveys using parent report may produce under-reporting related to parental monitoring, and it is also possible for school-based surveys to convey over-reporting due to in school peer effects [14].

A recent study examining self-reported concussion history among adults found no difference in lifetime prevalence when respondents randomly received a different definition of concussion [15]. The question wording in the present study varies primarily along two dimensions: the terms used (concussion and/or head injury and/or brain injury) and whether they reference a health care provider diagnosis. The NSCH and MTF inquire about diagnosis, whereas the NHIS does not. NSCH asks about “brain injury, concussion, or head injury,” NHIS asks about “head injury or concussion,” and MTF asks about “head injury.” The higher prevalence of LCHI seen in the NHIS among children 3–17 years, compared with the NSCH, may be due to inclusion of milder suspected injuries which did not receive a diagnosis. In addition, inclusion of “brain injury” in NSCH may have suggested only inclusion of more serious head injuries. Research on parent concussion reporting generally shows reliability in accounting for a concussion [15,16]. However, available reports primarily provide insight into parent reporting from a single location at the time of injury. Further research into the reliability of self-report to identify concussions from surveys is needed. Other research on pediatric health conditions has documented high concordance between parent report (i.e. asthma, psychiatric conditions, and autism spectrum disorder) and medical records or clinical report [16–20].

Among adolescents 13–17 years, the highest prevalence of LCHI was found in the MTF, nearly double that found in the NHIS and triple found in the NSCH. There are several possible explanations for this finding. First, the MTF used self-report, in contrast to the NHIS and NSCH which were based on parental report. Previous research suggests that parents may not always know whether their child sustained a concussion, and this may be the case for athletes who may actively hide concussions from coaches, parents, and other adults [21,22]. In fact, the results from one previous study demonstrated better parent-

student athlete agreement for athletic concussions (number of concussion symptoms and symptom severity) when parents were present at the time of injury [22]. The MTF question does not specify who gave the diagnosis, so it is possible that adolescents are including instances where they were told about a concussion by someone other than a health care provider, such as a sports coach or high school staff member.

Another reason for relatively higher prevalence found in MTF is that the question only asks about head injury, in contrast to NHIS and NSCH which ask about concussion and/or brain injury. This could connote to respondents about answering affirmatively for less severe head injuries, including those that do not result in any of the neurologic signs and symptoms that distinguish a head injury from a TBI. It is unknown how narrowly or broadly respondents interpret the term head injury in questions attempting to obtain estimates of concussion or TBI. Cognitive testing for the NHIS showed that most parents could state with certainty if their child had been diagnosed with a concussion, but other details were not as definite making it difficult to determine how the term “head injury” is understood by parents [23]. Further, MTF allowed for respondents to respond as “yes, once” or “yes, more than once,” so it is unknown how this may have contributed to respondents’ endorsement of concussion/head injury. Future research that examines how respondents interpret different elements of a question could help to better understand how questions affect prevalence estimates. Studies that can validate survey questions relative to a gold standard, such as an actual medical diagnosis or a previously validated TBI symptom inventory may be useful. Further, validation studies of parent versus youth report may be useful to understand how LCHI are reported. Evaluation of concussion/head injury using administrative data was beyond the scope of this report.

Despite differences in prevalence estimates, there were consistent patterns across surveys related to demographic characteristics associated with LCHI. For example, among children aged 3–17 years, there was a significant relationship within surveys examined between age and LCHI, even after controlling for demographic variables. It has been shown that older children have a higher prevalence because of a longer exposure period to sustain an injury and as adolescents have a higher occurrence of sports-related concussions than younger age groups and nonsport injury mechanisms [24,25]. In addition, boys had a higher prevalence of LCHI than girls in all surveys. This finding mirrors the past research and is often explained by boys engaging in riskier behaviors and having a higher prevalence of injury than female peers [26]. Further, studies consistently find that youth athletes in high contact sports dominated by boys (e.g., football) have the highest rate of concussions [9,26–28]. However, in gender comparable sports, such as soccer, females have a higher rate of concussions [27]. Further research on gender differences can help clarify how to best examine the relationship of gender to concussion prevalence.

Relationships between the socioeconomic variables captured in the surveys—current health insurance status, household income, parental educational attainment, and household primary language—and LCHI were not as clear or consistent across the surveys. Among children aged 3–17 years, the NHIS found an increased prevalence of LCHI among those who were uninsured compared with those who were privately insured, but this relationship was not found in the NSCH. However, as the NSCH inquired about a *diagnosis* of brain injury, this

difference may reflect the fact that some uninsured children in the NSCH were not able to visit a health care provider or receive a diagnosis. A diagnosis was not required in the NHIS and may have contributed to the higher rate of LCHI among the uninsured. Insurance status has previously been described as a predictor of seeking health care which may have contributed to prevalence differences [29]. Further research to examine lifetime measures of socioeconomic disadvantage (e.g., ever receipt of government assistance, economic hardship as captured by reports of difficulty paying for the basics such as food or housing) may offer more insight into the relationship of socioeconomic issues.

There are several limitations with respect to the surveys in this study. For all surveys, respondents may have had difficulty recalling past LCHI if they occurred long ago or resulted in mild or quickly resolved symptoms. Parents may not be aware of their children's concussion leading to under-reporting. Questions that include the term "head injury" maycontain false positives and have potential for overestimating concussion. As such, all surveys may incorrectly estimate the prevalence of LCHI among pediatric populations. In addition, all surveys are cross-sectional in nature, making it possible to only examine associations between LCHI and demographic, socioeconomic, and health-related factors, rather than causal factors. Further, this study focuses on point estimates of a LCHI in relationship to current socioeconomic indicators at the time of the survey. Health insurance, household income, and parent educational attainment may change over a child's lifetime, and so current socioeconomic status may not reflect the status at the time of a LCHI. Household language is approximated using different approaches in each of the surveys, which may have created misclassification.

Despite limitations, findings from these surveys contribute to understanding the burden of LCHI among children beyond estimates based solely on TBI-related ED visits. Estimates of pediatric LCHI prevalence ranged from 4% to 18% in the surveys examined. It is important to take into consideration the methodological differences across surveys when interpreting the prevalence estimates produced [10]. These surveys offer information about the burden of TBI among children and the association between LCHI and other health conditions. All surveys have additional questions for respondents that can be examined for a relationship with LCHI. For example, the NSCH has been used to demonstrate an association between lifetime history of LCHI and a higher occurrence of co-occurring health conditions such as attention-deficit/hyperactivity disorder, developmental delays, anxiety, depression, and speech/language problems was associated with a lifetime history of LCHI in the NSCH [4]. Furthermore, the inconsistency in results signals that validation of survey questions regarding LCHI may be useful. Identifying one or more standardized TBI questions may allow researchers to capture valid and stable estimates over time and across populations. This information can inform pediatric clinical providers who are assessing and managing TBI about the contribution of the child's medical history.

Conclusion

Although methodological differences exist across national surveys capturing pediatric LCHI, prevalence estimates and associations generated from these surveys make a substantial contribution to understanding the burden and distribution of injuries beyond health care

settings. Surveys can provide unique and potentially comprehensive data estimating and describing the burden, identifying subpopulations to target prevention efforts, and tracking prevalence over time. However, as shown in this study, estimates can differ, due to variations in question wording and survey methodology. In the absence of standardized, validated questions, current estimates should be interpreted with caution, considering differences between surveys. Future research can apply survey methods principles to develop standardized, validated questions to enhance the field of childhood TBI measurement and provide information clinicians can consider for diagnosis and management.

Acknowledgments

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest:

The authors have no conflicts of interest to disclose. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

[1]. Centers for Disease Control and Prevention. Surveillance Report of Traumatic Brain Injury-related Emergency Department Visits, Hospitalizations, and Deaths—United States, 2014. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; 2019.

[2]. Centers for Disease Control and Prevention. Report of Congress: The Management of Traumatic Brain Injury in Children. Atlanta, GA: National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention; 2018.

[3]. Arbogast KB, Curry AE, Pfeiffer MR. Point of health care entry for youth with concussion within a large pediatric care network. JAMA Pediatr 2016;170(7): e160294. [PubMed: 27244368]

[4]. Haarbauer-Krupa J, Lee AH, Bitsko RH, Zhang X, Kresnow-Sedacca MJ. Prevalence of Parent-Reported Traumatic Brain Injury in Children and Associated Health Conditions. JAMA Pediatr 2018;172(11):1078–86. [PubMed: 30264150]

[5]. Currie D, Snedden T, Pierpoint L, Comstock rD, Grubenhoff JA. Factors Influencing Primary Care Follow-Up After Pediatric Mild Traumatic Brain Injury. J Head Trauma Rehabil 2019;34(4):E11–9. [PubMed: 30608309]

[6]. Lever K, Peng J, Lundine JP. Attending Follow-up Appointments After Pediatric Traumatic Brain Injury: Caregiver-Perceived Barriers and Facilitators. J Head Trauma Rehabil 2019;34(2):E21–34. [PubMed: 30169437]

[7]. Snedden TR, Pierpoint LA, Currie DW, Comstock RD, Grubenhoff JA. Post-concussion academic support in children who attend a primary care provider follow-up visit after presenting to the emergency department. J Pediatr 2019;209:168–75. [PubMed: 30853206]

[8]. Black LI, Zammitti EP, Hoffman HJ, Li CM. Parental Report of Significant Head Injuries in Children Aged 3–17 Years: United States, 2016. Hyattsville, MD: Centers for Disease Control and Prevention, National Center for Health Statistics; 2018.

[9]. Veliz P, McCabe SE, Eckner JT, Schulenberg JE. Prevalence of Concussion Among US Adolescents and Correlated Factors. JAMA 2017;318(12):1180–2. [PubMed: 28973604]

[10]. Veliz P. Variation in National Survey Estimates and Youth Traumatic Brain Injury-Where Does the Truth Lie? JAMA Pediatr 2019;173(4):399.

[11]. Health Resources & Services Administration. National Survey of Children's Health. https://mchb.hrsa.gov/data/national-surveys; 2018 [accessed 24.02.20].

[12]. National Center for Health Statistics. National Health Interview Survey. https://www.cdc.gov/nchs/nhis/; 2020 [accessed 24.02.20].

[13]. National Institute on Drug Abuse. Monitoring the Future. https://www.drugabuse.gov/related-topics/trends-statistics/monitoring-future; 2020 [accessed 24.02.20].

[14]. Boyd CJ, Veliz P, Evans-Polce RJ, Eisman AB, McCabe SE. drugs. Why Are National Estimates So Different? A Comparison of Youth E-Cigarette Use and Cigarette Smoking in the MTF and PATH Surveys. J Stud Alcohol 2020;81(4): 497–504.

[15]. Daugherty J, DePadilla L, Sarmiento K, Breiding MJ. Self-Reported Lifetime Concussion Among Adults: Comparison of 3 Different Survey Questions. J Head Trauma Rehabil 2019:1–7. [PubMed: 30169439]

[16]. Bourgeois FT, Porter SC, Valim C, Jackson T, Cook EF, Mandl KD. The value of patient self-report for disease surveillance. J Am Med Inform Assoc 2007;14(6):765–71. [PubMed: 17712092]

[17]. Daniels AM, Rosenberg RE, Anderson C, Law JK, Marvin AR, Law PA. Verification of parent-report of child autism spectrum disorder diagnosis to a web-based autism registry. J Autism Dev Disord 2012;42(2):257–65. [PubMed: 21468770]

[18]. Porter SC, Forbes P, Manzi S, Kalish LA. Patients providing the answers: narrowing the gap in data quality for emergency care. Qual Saf Health Care 2010;19(5):e34.

[19]. Kentgen LM, Klein RG, Mannuzza S, Davies M. Test-retest reliability of maternal reports of lifetime mental disorders in their children. J Abnorm Child Psychol 1997;25(5):389–98. [PubMed: 9421747]

[20]. Zablotsky B, Black LI. Concordance between survey reported childhood asthma and linked Medicaid administrative records. J Asthma 2019;56(3): 285–95. [PubMed: 29771597]

[21]. Kroshus E, Garnett B, Hawrilenko M, Baugh CM, Calzo JP. Concussion under-reporting and pressure from coaches, teammates, fans, and parents. Soc Sci Med 2015;134:66–75. [PubMed: 25917137]

[22]. Rowhani-Rahbar A, Chrisman SP, Drescher S, Schiff MA, Rivara FP. Agreement between high school athletes and their parents on reporting athletic events and concussion symptoms. J Neurotrauma 2016;33(8):784–91. [PubMed: 26414288]

[23]. U.S. Census Bureau. 2016 National Survey of Children's Health Methodology Report. Suitland, MD: U.S. Census Bureau; 2018.

[24]. Ali B, Lawrence BA, Miller T, Allison J. Products and activities associated with non-fatal traumatic brain injuries in children and adolescents - United States 2010-2013. Brain Inj 2019:1–5.

[25]. Haarbauer-Krupa J, Arbogast KB, Metzger KB. Variations in Mechanisms of Injury for Children with Concussion. J Pediatr 2018;197:241–8. [PubMed: 29627189]

[26]. Kerr ZY, Chandran A, Nedimyer AK, Arakkal A, Pierpoint LA, Zuckerman SL. Concussion Incidence and Trends in 20 High School Sports. Pediatrics 2019;144(5):e20192180. [PubMed: 31615955]

[27]. Haarbauer-Krupa JK, Comstock D, Lionbarger M, Hirsch S, Kavee A, Lowe B. Healthcare professional involvement and RTP compliance in high school athletes with concussion. Brain Inj 2018.

[28]. Veliz P, Eckner JT, Zdroik J, Schulenberg JE. Lifetime prevalence of self-reported concussion among adolescents involved in competitive sports: a national US study. J Adolesc Health 2019;64(2):272–5. [PubMed: 30409755]

[29]. Zandieh SO, Gershel JC, Briggs WM, Mancuso CA, Kuder JM. Revisiting predictors of parental health care-seeking behaviors for nonurgent conditions at one inner-city hospital. Pediatr Emerg Care 2009;25(4):238–43. [PubMed: 19382324]

Table 1

Description of national surveys on key methodology parameters

	2016 National Survey of Children's Health (NSCH)	2016 National Health Interview Survey (NHIS)	2016 Monitoring the Future (MTF)
General Survey Information			
Survey sponsor	U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau	U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics	National Institutes of Health, National Institute on Drug Abuse
Survey administrator	U.S. Census Bureau	U.S. Census Bureau	University of Michigan, Institute for Social Research
Website	https://mchb.hrsa.gov/data/national-surveys	https://www.cdc.gov/nchs/nhis	https://www.drugabuse.gov/related-topics/trends-statistics/monitoring-future
Brief description	The NSCH examines the health and health care of noninstitutionalized U.S. children aged 0–17 y, including a breadth of sociodemographic, family, school, and neighborhood factors that might relate to the well being of children. National and state-level estimates are possible.	The NHIS monitors a broad range of health topics among the civilian noninstitutionalized U.S. population, including children aged 0—17 y. Information is collected on health status, illness, disability, and health care access. Data are weighted to produce national estimates.	The MTF measures drug and alcohol use and related attitudes among students in the 8th, 10th, and 12th grade attending U.S. public and private schools. Information is also collected on additional topics, such as demographic and family background, health-related symptoms and medical treatment, and values/attitudes about various societal aspects. Data are nationally representative.
Periodicity	Data collected annually since 2016 (between 2003 and 2016, data were collected every 4 y)	Data collected annually on children since 1997 (head injury only assessed in 2016)	Data collected annually since 1991 (since 1975 for 12th grade only)
Reporting source	Parent or other primary caregiver who resides in the household and is knowledgeable with the child's health and health care	Parent or knowledgeable adult who resides in the household	Student
Mode of administration	Self-administered Web or paper questionnaires	In-person household interviews by trained interviewers using computer-assisted personal interviewing	Self-administered paper questionnaires
Sampling frame	The NSCH sampling frame is developed from two Census Bureau data sources: the Master Address File (an up-to-date inventory of all household addresses in the U.S.) and a file of administrative flags (including information about number of children in a household by age, poverty, and Internet access).	The NHIS sampling frame consists of three nonoverlapping parts: the unit frame (a list of addresses purchased from a vendor); the area frame (geographic areas that do not have city-style addresses, and geographic areas where the unit frame was not considered to be a sufficient sampling resource); and the college dormitory frame (college residence hall spaces in the NHIS sample primary sampling units).	The MTF uses a multistage sampling procedure. Stage 1 is the selection of geographic areas within four regions (Northeast, South, Midwest, and West). Stage 2 is the random selection of public and private middle and secondary schools. Stage 3 is the selection of students within each school.
Weighting, poststratification	Weights adjusted for nonresponse, households with more than one child, and population controls. Poststratified by state, race, ethnicity, sex, age, family poverty ratio, household size, parental education, and special health care needs status.	Weights are based on design, ratio, nonresponse, and poststratification adjustments.	Corrective weighting is used to account for the unequal probabilities of selection that occur at each stage of the 3-stage sampling procedures (geographic areas, high school, and individual students).
Information about 2016 survey administration			
Survey administration timeframe	June 2016–February 2017	January 2016–December 2016	Spring 2016

	2016 National Survey of Children's Health (NSCH)	2016 National Health Interview Survey (NHIS)	2016 Monitoring the Future (MTF)
Total sample size	50,212 children 0–17 y	11,107 children 0–17 y (Sample Child File)	13,088 8th, 10th, and 12th graders
Number of children ages 3–17 y	43,283	9247	N/A
Number of adolescents 13–17 y	17,783	3392	10,985
Use of incentives	33% of households received $5, 33% received $2, and 33% received no incentive	None	Payments to schools that participate
Response rate	40.7% overall response rate, 69.7% topical questionnaire conversion interview completion rate *	61.9% final response rate, 92.3% conditional response rate †	90% for 8th graders, 88% for 10th graders, 80% for 12th graders
Proxy versus self-report	Proxy	Proxy	Self-report
Questionnaire item assessing lifetime concussion/head injury	"Has a doctor or other health care provider ever told you that this child has … Brain Injury, Concussion, or Head Injury?" Respondents were not provided any additional definitions or context for the question.	"In his/her lifetime, has (child name) ever had a significant head injury or concussion?"	"Have you ever had a head injury that was diagnosed as a concussion?"
Response options	Yes	Yes	Yes, once
	No	No	Yes, more than once No
Concussion/head injury prevalence among 3–17-year olds	3.6%	7.0%	N/A
Concussion/head injury prevalence among 13–17-year olds	6.5%	10.2%	18.3%

* The interview completion rate is the proportion of screened households with children who initiated the survey that went on to complete the topical questionnaire.

† The conditional response rate is the number of completed sample child interviews divided by the total number of eligible sample children.

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Table 2

Prevalence of selected sociodemographic characteristics among the population of children and adolescents by national survey

	Children 3–17 Y					
	2016 NSCH (*n* = 43,283)			2016 NHIS (*n* = 9247)		
	n	**Weighted %**	**95% CI**	***n***	**Weighted %**	**95% CI**
Age						
3–5 y	7565	19.5	18.7–20.4	1781	20.4	19.3–21.5
6–8 y	7052	20.2	19.3–21.1	1760	19.9	18.8–21.0
9–12 y	10,883	26.6	25.7–27.6	2314	26.1	24.9–27.3
13–15 y	9877	20.3	19.5–21.1	1940	20.3	19.3–21.4
16–17 y	7906	13.4	12.7–14.1	1452	13.3	12.5–14.2
Sex						
Male	22,194	51.0	50.0–52.1	4777	51.1	49.8–52.5
Female	21,089	49.0	47.9–50.0	4470	48.9	47.5–50.2
Race/ethnicity						
White, non-Hispanic	30,386	51.7	50.6–52.8	5054	51.7	50.1–53.3
Hispanic	4771	24.9	23.7–26.1	2030	24.6	23.1–26.1
Black, non-Hispanic	2564	13.0	12.2–13.7	1091	13.8	12.8–14.9
Other, non-Hispanic	5562	10.5	9.9–11.0	1072	9.9	9.1–10.8
Current health insurance status						
Private	32,223	58.5	57.4–59.6	5289	54.6	53.1–56.1
Public	7801	30.8	29.7–31.9	3167	37.1	35.6–38.6
Other	1122	2.6	2.3–3.0	246	2.3	1.9–2.8
Uninsured	1505	5.9	5.3–6.6	494	5.5	4.9–6.1
Missing	632	2.2	1.9–2.6	51	0.5	0.4–0.7
Household income						
<100% FPL	4249	21.3	20.2–22.4	1493	19.2	18.0–20.5
100%–199% FPL	6917	22.3	21.3–23.3	2020	23.0	21.8–24.3
200%–399% FPL	13,332	26.8	25.8–27.8	2762	28.8	27.5–30.1
≥400% FPL	18,785	29.6	28.7–30.5	2971	28.9	27.5–30.4
Parental education attainment						

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	Children 3–17 Y					
	2016 NSCH (*n* = 43,283)			2016 NHIS (*n* = 9247)		
	n	**Weighted %**	**95% CI**	***n***	**Weighted %**	**95% CI**
Less than high school	991	9.4	8.4–10.4	831	10.6	9.6–11.6
High school diploma	5404	19.2	18.3–20.2	1584	16.9	15.9–17.9
Some college	9686	21.9	21.1–22.8	2807	29.0	27.7–30.3
College degree or higher	26,160	46.1	45.1–47.2	3645	40.1	38.5–41.6
Missing	1042	3.4	3.0–3.7	380	3.5	3.0–4.0
Household primary language						
English	40,325	85.0	83.9–86.0	8541	90.5	89.4–91.5
Non-English	2630	13.7	12.7–14.7	699	9.3	8.3–10.4
Missing	328	1.3	1.0–1.7	7	0.1	0.1–0.4

	Adolescents 13–17 Y								
	2016 NSCH (*n* = 17,783)			2016 NHIS (*n* = 3392)			2016 MTF (*n* = 10,985)		
	n	**Weighted %**	**95% CI**	***n***	**Weighted %**	**95% CI**	***n***	**Weighted %**	**95% CI**
Age									
3–5 y	–	–	–	–	–	–	–	–	–
6–8 y	–	–	–	–	–	–	–	–	–
9–12 y	–	–	–	–	–	–	–	–	–
13–15 y	9877	60.2	58.5–61.8	1940	60.4	58.2–62.5	8004	78.0	74.1–81.4
16–17 y	7906	39.8	38.2–41.5	1452	39.6	37.5–41.8	2260	22.0	18.5–25.8
Sex									
Male	9016	51.1	49.4–52.8	1720	51.4	49.1–53.7	5196	49.8	48.5–50.9
Female	8767	48.9	47.2–50.6	1672	48.6	46.3–50.9	5232	50.2	49.0–51.4
Race/ethnicity									
White, non-Hispanic	12,852	52.9	51.2–54.6	1908	53.8	51.5–56.2	4883	44.6	40.6–48.6
Hispanic	1814	24.0	22.2–26.0	737	23.7	21.6–25.9	1331	12.5	10.1–15.3
Black, non-Hispanic	1060	13.9	12.7–15.3	384	13.1	11.5–14.8	2330	21.1	17.6–24.9
Other, non-Hispanic	2057	9.2	8.4–10.0	363	9.4	8.2–10.8	2441	21.8	20.1–23.5
Current health insurance status									
Private	13,457	60.1	58.3–61.9	2048	57.7	55.5–59.9	–	–	–

	Adolescents 13–17 Y								
	2016 NSCH (*n* = 17,783)			2016 NHIS (*n* = 3392)			2016 MTF (*n* = 10,985)		
	n	**Weighted %**	**95% CI**	***n***	**Weighted %**	**95% CI**	***n***	**Weighted %**	**95% CI**
Public	2773	27.2	25.5–28.9	1015	33.0	30.8–35.2	–	–	–
Other	558	3.6	2.9–4.6	93	2.5	1.9–3.3	–	–	–
Uninsured	689	6.3	5.4–7.4	220	6.5	5.4–7.7	–	–	–
Missing	306	2.7	2.1–3.6	16	0.3	0.2–0.5	–	–	–
Household income									
<100% FPL	1627	21.0	19.0–22.9	495	17.7	15.8–19.7	–	–	–
100%–199% FPL	2600	21.4	19.7–23.1	695	21.5	19.7–23.5	–	–	–
200%–399% FPL	5397	26.3	24.5–28.1	982	28.3	26.3–30.4	–	–	–
≥400% FPL	8159	31.3	29.9–32.8	1220	32.5	30.5–34.6	–	–	–
Parental education attainment									
Less than high school	435	10.2	8.7–11.9	330	11.9	10.2–13.7	916	8.4	7.3–9.6
High school diploma	2436	20.8	19.3–22.3	572	15.7	14.2–17.4	1621	14.5	13.2–15.8
Some college	4223	22.9	21.6–24.2	1009	28.4	26.4–30.4	1486	13.6	12.5–14.6
College degree or higher	10,259	42.4	40.8–44.0	1327	39.9	37.5–42.2	5585	51.4	48.4–54.3
Missing	430	3.8	3.2–4.5	154	4.2	3.4–5.1	1377	12.1	11.0–13.3
Household primary language *									
English	16,700	85.8	84.0–87.4	3122	89.7	87.9–91.2	8491	78.2	75.5–80.6
Non-English	937	13.0	11.4–14.7	269	10.3	8.8–12.1	2054	18.2	15.9–20.7
Missing	146	1.3	0.9–1.9	1	0.0	0.0–0.2	440	3.6	3.1–4.1

FPL is federal poverty level.

* In the NSCH, household primary language was assessed with the survey item “What is the primary language spoken in the household?” In the NHIS, this was approximated by the language the interview was conducted in. In the MTF, this was ascertained by asking “What was the first language you spoke when you were a child?”.

Table 3

Prevalence estimates of lifetime concussion/head injury among children 3–17 y: Overall and by sociodemographic characteristics

	2016 NSCH *n* = 43,101*				2016 NHIS *n* = 9143			
	% Ever	95% CI	Weighted pop size	*P*-value	% Ever	95% CI	Weighted pop size	*P*-value
Overall	3.6	3.3–3.9	2,218,969		7.0	6.4–7.7	4,286,296	
Age								
3–5 y	1.4	1.0–1.8	162,430	**<.0001**	4.0	3.0–5.2	494,062	**<.0001**
6–8 y	2.2	1.7–2.9	270,421		5.7	4.5–7.3	698,016	
9–12 y	2.7	2.3–3.2	447,530		6.2	5.1–7.6	995,134	
13–15 y	6.0	5.2–6.9	744,957		8.7	7.2–10.4	1,075,583	
16–17 y	7.2	6.3–8.3	593,632		12.5	10.5–14.9	1,023,501	
Sex								
Male	4.2	3.8–4.6	1,309,776	**.0001**	8.3	7.4–9.4	2,608,528	**.0001**
Female	3.0	2.7–3.4	909,194		5.6	4.9–6.5	1,677,768	
Race/ethnicity								
White, non-Hispanic	4.8	4.4–5.3	1,536,264	**<.0001**	8.7	7.8–9.7	2,746,609	**<.0001**
Hispanic	2.2	1.7–2.8	329,927		5.7	4.5–7.2	857,242	
Black, non-Hispanic	2.5	1.8–3.3	195,581		4.9	3.5–6.7	409,914	
Other, non-Hispanic	2.5	1.9–3.2	157,197		4.5	3.3–6.1	272,531	
Current health insurance status								
Private	4.3	3.9–4.7	1,538,763	**<.0001**	6.9	6.1–7.8	2,311,273	.3731
Public	2.6	2.2–3.2	493,364		6.7	5.7–7.8	1,519,672	
Other	4.1	2.6–6.3	64,447		10.4	5.9–17.8	143,659	
Uninsured	2.2	1.4–3.4	79,158		9.2	6.2–13.5	306,556	
Household income								
<100% FPL	2.5	1.8–3.2	361,513	**<.0001**	6.5	5.1–8.4	766,368	.2484
100%–199% FPL	2.8	2.1–3.6	354,708		6.8	5.6–8.3	959,592	
200%–399% FPL	3.7	3.1–4.4	626,231		6.4	5.4–7.6	1,130,274	
≥400% FPL	4.9	4.3–5.5	876,517		8.1	6.9–9.4	1,430,063	
Parental education attainment								

	2016 NSCH *n* = 43,101*				2016 NHIS *n* = 9143			
	% Ever	95% CI	Weighted pop size	*P*-value	% Ever	95% CI	Weighted pop size	*P*-value
Less than high school	1.6	0.9–3.0	94,247	**<.0001**	5.9	4.2–8.4	383,612	.1055
High school diploma	2.8	2.2–3.4	326,815		5.8	4.5–7.4	597,326	
Some college	3.6	3.1–4.2	481,287		8.0	6.8–9.4	1,429,809	
College degree or higher	4.4	4.0–4.8	1,246,127		7.1	6.1–8.3	1,748,639	
Household primary language†								
English	4.1	3.7–4.4	2,121,850	**<.0001**	7.2	6.5–7.9	3,972,572	.1599
Non-English	0.8	0.5–1.3	67,385		5.5	3.7–8.1	313,724	

Bolded values indicate statistical significance. FPL is federal poverty level.

*This sample size includes those who had data for concussion/head injury and does not include missing data from the total sample (*n* = 182).

†In the NSCH, household primary language was assessed with the survey item “What is the primary language spoken in the household?” In the NHIS, this was approximated by the language the interview was conducted in. In the MTF, this was ascertained by asking “What was the first language you spoke when you were a child?”

Ann Epidemiol. Author manuscript; available in PMC 2021 May 27.

Table 4

Adjusted prevalence rate ratios (aPRRs) for lifetime concussion/head injury among children 3–17 y by sociodemographic characteristics

	2016 NSCH *n* = 41,226		2016 NHIS *n* = 8725	
	aPRR	**95% CI**	**aPRR**	**95% CI**
Overall				
Age				
3–5 y (referent)	1.00		1.00	
6–8 y	**1.81**	**1.05–2.56**	1.45	0.99–2.14
9–12 y	**2.26**	**1.46–3.06**	**1.50**	**1.05–2.16**
13–15 y	**4.69**	**3.10–6.28**	**2.14**	**1.53–3.00**
16–17 y	**5.67**	**3.74–7.61**	**3.19**	**2.27–4.48**
Sex				
Male (referent)	1.00		1.00	
Female	**0.69**	**0.58–0.80**	**0.69**	**0.57–0.83**
Race/ethnicity				
White, non-Hispanic (referent)	1.00		1.00	
Hispanic	**0.63**	**0.44–0.82**	**0.66**	**0.49–0.90**
Black, non-Hispanic	**0.58**	**0.39–0.77**	**0.51**	**0.36–0.73**
Other, non-Hispanic	**0.63**	**0.44–0.82**	**0.49**	**0.35–0.69**
Current health insurance status				
Private (referent)	1.00		1.00	
Public	0.95	0.69–1.21	1.26	0.96–1.66
Other	0.87	0.44–1.30	1.55	0.83–2.89
Uninsured	0.88	0.44–1.32	**1.58**	**1.02–2.44**
Household income				
<100% FPL	0.90	0.55–1.26	0.97	0.67–1.40
100%–199% FPL	0.83	0.57–1.09	0.91	0.66–1.27
200%–399% FPL	0.91	0.72–1.09	0.79	0.62–1.01
≥400% FPL (referent)	1.00		1.00	
Parental education attainment				
Less than high school	0.63	0.18–1.07	0.87	0.59–1.29
High school diploma	**0.68**	**0.49–0.88**	0.87	0.64–1.18
Some college	0.86	0.68–1.04	1.19	0.93–1.51
College degree or higher (referent)	1.00		1.00	
Household primary language *				
English (referent)	1.00		1.00	
Non-English	**0.32**	**0.14–0.49**	1.07	0.68–1.69

Bolded values indicate statistical significance. FPL is federal poverty level.

[*] In the NSCH, household primary language was assessed with the survey item “What is the primary language spoken in the household?” In the NHIS, this was approximated by the language the interview was conducted in. In the MTF, this was ascertained by asking “What was the first language you spoke when you were a child?”

Table 5

Prevalence estimates of lifetime concussion/head injury among adolescents 13–17 y: Overall and by sociodemographic characteristics

	2016 NSCH *n* = 17,707				2016 NHIS *n* = 3349				2016 MTF *n* = 10,985			
	% Ever	95% CI	Weighted pop size	*P*-value	% Ever	95% CI	Weighted pop size	*P*-value	% Ever	95% CI	Weighted pop size	*P*-value
Overall	6.5	5.9–7.1	1,338,589		10.2	9.0–11.6	2,099,084		18.3	17.2–19.3	3,767,323	
Age												
13–15 y	6.0	5.2–6.9	744,957	.0603	8.7	7.2–10.4	1,075,583	**.0061**	17.2	16.2–18.4	2,130,991	**.0132**
16–17 y	7.2	6.3–8.3	593,632		12.5	10.5–14.9	1,023,501		20.1	18.1–22.4	1,651,507	
Sex												
Male	7.0	6.2–8.0	743,906	.0778	12.2	10.3–14.4	1,287,089	**.0022**	22.1	20.5–23.6	2,340,074	**<.0001**
Female	5.9	5.0–6.9	594,683		8.1	6.7–9.8	811,995		14.6	13.4–15.8	1,467,593	
Race/ethnicity												
White, non-Hispanic	8.6	7.8–9.5	941,979	**<.0001**	13.1	11.4–15.1	1,449,999	**<.0001**	21.9	20.4–23.5	2,411,402	**<.0001**
Hispanic	4.0	2.8–5.6	198,722		6.2	4.2–9.1	301,089		14.8	12.5–17.5	727,000	
Black, non-Hispanic	3.5	2.4–5.1	100,459		8.7	5.6–13.5	234,654		12.6	11.0–14.5	350,749	
Other, non-Hispanic	5.1	3.7–7.1	97,429		5.8	3.7–9.2	113,342		18.0	16.3–19.8	347,809	
Current health insurance status												
Private	7.7	6.9–8.5	954,392	**.0003**	10.6	9.1–12.3	1,258,885	.7952	–	–	–	–
Public	4.3	3.3–5.6	242,222		9.4	7.4–11.8	635,188		–	–	–	
Other	7.4	4.4–12.2	55,268		10.6	4.8–21.5	51,376		–	–	–	
Uninsured	4.4	2.5–7.5	57,337		11.6	6.6–19.7	153,635		–	–	–	–
Household income												
<100% FPL *	3.5	2.2–4.7	157,640	**<.0001**	8.3	5.7–11.9	297,957	.1090	–	–	–	–
100%–199% FPL	5.1	3.3–6.9	198,283		10.1	7.4–13.4	441,320		–	–	–	
200%–399% FPL	7.0	5.6–8.4	394,577		9.0	7.0–11.4	521,478		–	–	–	
≥400% FPL	9.0	7.8–10.3	588,090		12.5	10.4–15.0	838,329		–	–	–	
Parental education attainment												
Less than high school	2.7	1.2–6.3	57,170	**.0002**	7.2	4.3–12.0	175,864	.0755	12.4	9.8–15.6	282,717	**<.0001**
High school diploma	4.3	3.3–5.7	186,006		8.0	5.4–11.7	257,513		16.4	14.0–19.2	618,660	

	2016 NSCH				2016 NHIS				2016 MTF			
	n = 17,707				*n* = 3349				*n* = 10,985			
	% Ever	95% CI	Weighted pop size	*P*-value	% Ever	95% CI	Weighted pop size	*P*-value	% Ever	95% CI	Weighted pop size	*P*-value
Some college	6.4	5.3–7.8	303,026		11.4	9.1–14.3	668,471		16.0	14.0–18.3	757,698	
College degree or higher	8.4	7.5–9.4	735,275		11.5	9.5–13.7	940,607		20.8	19.3–22.4	1,760,976	
Household primary language[†]												
English	7.3	6.6–8.0	1,292,858	**<.0001**	10.7	9.4–12.1	1,964,044	.0658	19.3	18.2–20.5	3,480,362	**<.0001**
Non-English	0.9	0.5–1.8	24,288		6.4	3.3–12.1	135,040		13.4	11.8–15.2	322,177	

[*] Bolded values indicate statistical significance. FPL is federal poverty level.

[†] In the NSCH, household primary language was assessed with the survey item “What is the primary language spoken in the household?” In the NHIS, this was approximated by the language the interview was conducted in. In the MTF, this was ascertained by asking “What was the first language you spoke when you were a child?”

Table 6

Adjusted prevalence rate ratios (aPRRs) for lifetime concussion/head injury among adolescents 13–17 y by sociodemographic characteristics

	2016 NSCH (*n* = 17,145)		2016 NHIS (*n* = 3200)		2016 MTF (*n* = 10,985)	
	aPRR	**95% CI**	**aPRR**	**95% CI**	**aPRR**	**95% CI**
Age						
13–15 y (referent)	1.00		1.00		1.00	
16–17 y	1.22	0.99–1.44	**1.47**	**1.14–1.90**	**1.18**	**1.02–1.39**
Sex						
Male (referent)	1.00		1.00		1.00	
Female	**0.79**	**0.64–0.94**	**0.67**	**0.52–0.88**	**0.60**	**0.54–0.68**
Race/ethnicity						
White, non-Hispanic (referent)	1.00		1.00		1.00	
Hispanic	**0.66**	**0.42–0.89**	**0.46**	**0.30–0.72**	**0.68**	**0.54–0.87**
Black, non-Hispanic	**0.46**	**0.27–0.64**	0.66	0.42–1.04	**0.61**	**0.47–0.78**
Other, non-Hispanic	**0.72**	**0.47–0.97**	**0.38**	**0.23–0.64**	**0.82**	**0.68–0.99**
Parental education attainment						
Less than high school	0.58	0.02–1.13	0.90	0.55–1.48	0.75	0.55–1.03
High school diploma	**0.61**	**0.43–0.78**	0.80	0.52–1.21	0.89	0.70–1.11
Some college	0.82	0.64–1.00	1.09	0.82–1.45	**0.78**	**0.65–0.94**
College degree or higher (referent)	1.00		1.00		1.00	
Household primary language *						
English	1.00		1.00		1.00	
Non-English (referent)	**0.17**	**0.04–0.30**	0.87	0.46–1.64	0.90	0.73–1.11

Bolded values indicate statistical significance.

* In the NHIS, this was approximated by the language the interview was conducted in. In the MTF, this was ascertained by asking “What was the first language you spoke when you were a child (English/Spanish/Other)?”