



Traumatic Brain Injury and Psychiatric Co-Morbidity in the United States

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Abstract

The objective of the present study was to provide a nationally representative psychiatric epidemiologic investigation of traumatic brain injury (TBI) and its co-morbid conditions. Data from the National Epidemiologic Survey of Alcohol and Related Conditions (NESARC-III) collected between 2012 and 2013 was used. Results indicated that TBI was significantly associated with any lifetime mental health (AOR = 2.32, 95% CI = 1.65–3.70), substance use disorder (AOR = 1.57–1.01–2.42), and violent (AOR = 1.65, 95% CI = 1.03–2.65) and nonviolent (AOR = 1.84, 95% CI = 1.25–2.70) criminal behaviors. In our study, TBI was highly comorbid with psychiatric disorders and especially antisocial behaviors, both violent and non-violent.

Keywords Traumatic brain injury · TBI · Violence · Substance use · Mental health

Traumatic brain injury (TBI) — cell or tissue damage resulting from a blow or jolt to the head leading to a broad array of physical and cognitive symptoms— is now being recognized as a complex yet important medical and public health problem. TBI is linked to a wide number of adverse consequences including suicide [1, 2], substance use disorders [3–7], mood disorders [6–12], posttraumatic stress disorder [7, 13, 14], sleep disorder [15–17], and impulsivity [18]. Indeed, recent studies estimates suggest that TBI and its consequences represent an important source of social and economic burden in terms of healthcare costs and losses in productivity [19–24].

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Despite a growing body of research on TBI, there is a limited number of nationally representative psychiatric epidemiologic investigations of its prevalence and co-morbid conditions. This is necessary to complement clinical studies and provide population-level surveillance information for health policy and prevention efforts. Thus, the aim of the current study is to draw from a nationally representative survey (National Epidemiologic Survey on Alcohol and Related Conditions [NESARC], 2012–2013) designed and implemented by the National Institutes of Health, and examine the prevalence and psychiatric correlates of TBI in this well characterized data source. Based on prior research on TBI [4, 5, 18, 25], we hypothesize that individuals reporting a past-year TBI will be more likely than their non-TBI reporting counterparts to experience psychiatric and inhibitory control deficits (i.e., substance use disorders, antisocial behavior) either due to the consequences of TBI and/or the etiologic propensity that gives rise to the probability of suffering both a TBI and experiencing these behavioral problems.

Method

Sample and Procedures

Study findings are based on the NESARC-III data collected between 2012 and 2013 [26]. The NESARC-III is a nationally representative survey of 36,309 non-institutionalized adults ages 18 and older in the US. Utilizing a multistage cluster sampling design and oversampling minority populations, the study interviewed civilian, noninstitutionalized individuals living in all 50 states and Washington, DC. Interviewers administered the NIAAA Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS-5), which provides diagnoses for substance use disorders and related outcomes [27]. The data collection and analysis meets all human subjects requirements and has been performed in accordance with ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Survey Measures

Traumatic Brain Injury All participants were asked: “During the past 12 months, did you have a serious or traumatic brain injury?” (no, yes). Of those reporting a past year brain injury, 93% reported that a doctor or other health professional diagnosed them with TBI.

Mental Health and Substance Use Disorders Using the AUDADIS-5, we examined an array of lifetime mental health and substance use disorders (see Table 1). To ensure stable prevalence estimates and allow for examination of subgroups, analyses were conducted only using outcomes with a prevalence of at least 1.5% in the general population.

Antisocial Conduct We examined 10 items (no, yes) related to lifetime involvement in violent (e.g., frequent fight starting, use of weapons in fights) and nonviolent criminal (e.g., property destruction, making illegal money) behaviors measured as part of the antisocial personality disorder module in the AUDADIS-5 (see Vaughn et al. [28] for more on antisocial items used in the NESARC). Using these 10 items, we also created an antisocial behavioral index ($\alpha = 0.78$) ranging from involvement in zero to ten behaviors in total.

Table 1 Past year mental and substance use disorders among individuals reporting traumatic brain injury in the United States

		“During the past 12 months did you have a serious or traumatic brain injury?”		Unadjusted		Adjusted	
		Yes		OR		AOR	
		No	Yes	OR	(95% CI)	AOR	(95% CI)
		%	%				
Mental Health							
Any Disorder							
No	77.83	(77.1–78.5)	54	(45.2–62.6)		1.00	
Yes	22.17	(21.5–22.9)	46	(37.4–54.8)	2.99	2.72	(1.90–3.88)
Generalized Anxiety							
No	94.74	(94.4–95.0)	85.92	(75.7–92.3)		1.00	
Yes	5.26	(5.0–5.6)	14.08	(7.7–24.3)	2.94	2.52	(1.27–5.01)
Bipolar I							
No	98.49	(98.3–98.6)	93.18	(84.5–97.2)		1.00	
Yes	1.51	(1.4–1.7)	6.81	(2.8–15.5)	4.75	3.38	(1.26–9.06)
Major Depressive							
No	89.67	(89.2–90.2)	81.14	(72.7–87.4)		1.00	
Yes	10.33	(9.8–10.8)	18.86	(12.6–27.3)	2.01	1.74	(1.02–2.96)
Persistent Depressive (Dysthymia)							
No	96.96	(96.6–97.2)	88.75	(80.3–93.9)		1.00	
Yes	3.08	(2.8–3.4)	11.25	(6.1–19.7)	3.98	3.10	(1.48–6.49)
Panic							
No	96.95	(96.7–97.2)	92.4	(85.6–96.1)		1.00	
Yes	3.05	(2.8–3.3)	7.60	(3.9–14.4)	2.61	2.07	(1.01–4.24)
Specific Phobia							
No	92.47	(92.1–92.8)	83.25	(77.0–88.0)		1.00	
Yes	7.53	(7.2–8.0)	16.75	(12.0–23.0)	2.47	2.21	(1.46–3.33)
Posttraumatic Stress							
No	95.4	(95.1–95.7)	82.9	(74.6–88.9)		1.00	
Yes	4.60	(4.3–5.0)	17.1	(11.1–25.4)	4.27	3.60	(2.17–5.97)
Substance Use							
Any Disorder							
No	84.5	(83.8–85.1)	75.2	(68.0–81.3)		1.00	
Yes	15.5	(14.9–16.2)	24.8	(18.7–32.1)	1.79	1.55	(1.09–2.19)

Table 1 (continued)

		“During the past 12 months did you have a serious or traumatic brain injury?”		Unadjusted		Adjusted	
		Yes		OR		AOR	
		%		(95% CI)		(95% CI)	
		%		(95% CI)		(95% CI)	
Alcohol							
No	86.19	(85.6–87.0)	78.62	(70.9–84.7)	1.00	1.00	
Yes	13.81	(13.2–14.5)	21.38	(15.3–29.1)	1.69	1.51	(1.02–2.23)
Cannabis							
No	97.47	(97.2–97.7)	95.03	(90.1–97.6)	1.00	1.00	
Yes	2.53	(2.3–2.8)	4.97	(2.4–9.9)	2.01	1.38	(0.66–2.88)
Other Illicit Drug							
No	98.47	(98.3–99.0)	93.8	(87.2–97.1)	1.00	1.00	
Yes	1.53	(1.4–1.7)	6.19	(2.9–12.8)	4.24	2.58	(1.11–6.01)

Adjusted odds ratios (AOR) for traumatic brain injury (TBI) adjusted for age, gender, race/ethnicity, household income, education level, marital status, and parental history of anxiety and depression. Odds ratios and 95% confidence intervals in bold are statistically significant

Sociodemographic and Parental Controls Sociodemographic variables commonly used in NESARC-based studies as control variables were included: age, gender, race/ethnicity, household income, education level, and marital status. We also controlled for respondent report of parental history of anxiety or depression (e.g., “Were your blood or natural mother or father depressed at any time in their lives?”).

Statistical Analyses

Binomial logistic regression was employed to examine the relationship between TBI and key outcomes. Adjusted odds ratios (AORs) were considered to be statistically significant if the associated 95% confidence intervals did not cross the 1.00 threshold when controlling for sociodemographic and parental factors. For all statistical analyses, weighted prevalence estimates and standard errors were computed using Stata 15.1 MP software. This system implements a Taylor series linearization to adjust standard errors of estimates for complex survey sampling design effects, including clustered data.

Results

The prevalence of TBI among NESARC participants is 0.53% (95% CI = 0.43–0.64). Examination of the association between sociodemographic and parental factors (not shown) revealed that Asians/Pacific Islanders (AOR = 0.27, 95% CI = 0.08–0.96) and Hispanics (AOR = 0.55, 95% CI = 0.32–0.99) were significantly less likely than non-Hispanic whites to report a TBI. Also, compared with individuals in households earning less than \$20,000 per year, those in families with higher incomes were less likely to report a past year TBI (\$20 k–\$34,999: AOR = 0.46, 95% CI = 0.27–0.79; \$35 k–\$69,999: AOR = 0.46, 95% CI = 0.27–0.81; \$70 k+: AOR = 0.32, 95% CI = 0.14–0.73). High school graduates were also less likely than non-graduates to report a TBI (AOR = 0.50, 95% CI = 0.26–0.99). Participants reporting parental history of anxiety/depression were not more likely to report a TBI.

As shown in Table 1, controlling for sociodemographic and parental factors, TBI was significantly associated with past year diagnosis of all mental health disorders examined (AORs ranging from 1.74 [major depressive disorder] to 3.38 [bipolar I]). TBI was also associated with any past year SUD (AOR = 1.55, 95% CI = 1.55), alcohol use disorder (AOR = 1.51, 95% CI = 1.02–2.23), and other illicit drug (excluding cannabis) use disorder (AOR = 2.58, 95% CI = 1.11–6.01). Cannabis use disorder was not significantly associated with TBI. Supplemental analyses (not shown) revealed a similar pattern of results for lifetime mental health and substance use disorders as TBI was significantly associated with diagnosis of any lifetime mental health (AOR = 2.32, 95% CI = 1.65–3.70) and substance use disorder (AOR = 1.57–1.01–2.42).

Supplemental analyses also revealed, while controlling for the same list of demographic confounds and parental history of antisocial conduct, a significant association between risk for TBI and involvement in one or more violent (AOR = 1.65, 95% CI = 1.03–2.65) and nonviolent (AOR = 1.84, 95% CI = 1.25–2.70) criminal behaviors. Using the previously described antisocial behavioral index we found that the odds of TBI increased by 21% with each additional behavior listed. Indeed, prevalence of TBI among those reporting no lifetime antisocial behavior is quite low (0.38%) but increased among those reporting 1–2 (0.75%) or

3–6 (0.96%) behaviors; however, the prevalence of TBI among the fraction of adults—only 1.05% of the population—reporting involvement in 7 or more antisocial behaviors was 4.0%.

Discussion

Findings from the present nationally representative sample provide clear results that TBI is highly comorbid with psychiatric disorders and especially antisocial behaviors, both violent and non-violent. Notably, these associations were observed while controlling for numerous sociodemographic confounds. This pattern of findings is in keeping with a burgeoning line of inquiry showing that TBI is associated with substance use disorders [3–7], but extends previous research on adding antisocial behavior to the nexus. Participants reporting a past-year TBI were markedly more likely to engage in violent and non-violent illegal acts demonstrating a severe disinhibited behavioral phenotype consistent with extreme offenders [29, 30]. Simply put, our results suggest that TBI participants are greatly compromised in their health and well-being and representing tremendous economic burden and lost opportunity.

Findings from the present study should be interpreted in light of several limitations. First, we were unable to account for potential self-report biases relevant to the assessment of TBI and psychiatric disorders, especially those pertaining to memory or recall issues. This is an important limitation as it is certainly plausible that TBI positive respondent may have under- or over-reported due to ongoing neuropsychological problems. Moreover, the assessment of TBI is undifferentiated aggregating mild, moderate, and possibly severe forms. A second limitation is that NESARC-III data is fundamentally cross-sectional and any causal inferences regarding whether inhibitory control deficits or mental health disorders are a direct result of a TBI cannot be made. There is every reason to expect some degree of reverse causation owing to the intertwined nexus of TBI and these consequences. Finally, although the NESARC gathers data on an array of salient sociodemographic and psychiatric disorders, specific contextual, situational, and genetic factors that may play a role in TBI risk and sequelae are not collected. Despite these limitations, the present analysis provides a baseline psychiatric epidemiologic portrait of TBI in the general population.

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Compliance with Ethical Standards

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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