Dangerous weapons or dangerous people? The temporal associations between gun violence and mental health

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ABSTRACT

Despite the public, political, and media narrative that mental health is at the root of gun violence, evidence is lacking to infer a causal link. This study examines the temporal associations between gun violence (i.e., threatening someone with a gun and gun carrying) and mental health (i.e., anxiety, depression, stress, PTSD, hostility, impulsivity, and borderline personality disorder) as well the cross-sectional associations with gun access and gun ownership in a group of emerging adults. Waves 6 (2015) and 8 (2017) data were used from a longitudinal study in Texas, US. Participants were 663 emerging adults (61.7% female) including 33.6% self-identified Hispanics, 26.0% white, 27.0% Black, and 13.4% other, with an average age of 22 years. Multivariate logistic regression indicated that, individuals who had gun access were 18.15 times and individuals with high hostility were 3.51 times more likely to have threatened someone with a gun, after controlling for demographic factors and prior mental health treatment. Individuals who had gun access were 4.74 times, individuals who reported gun ownership were 5.22 times, and individuals with high impulsivity were 1.91 times more likely to have carried a gun outside of their homes, after controlling for prior gun carrying, mental health treatment, and demographic factors. Counter to public beliefs, the majority of mental health symptoms examined were not related to gun violence. Instead, access to firearms was the primary culprit. The findings have important implications for gun control policy efforts.

1. Introduction

Each year, an estimated 75,000 to 100,000 Americans are non-fatally injured by firearms and 30,000–40,000 die from firearms (Galea et al., 2018; Swanson et al., 2015; Xu et al., 2018). About a third of the US annual gun-related deaths are homicides with the remaining attributed to suicide (61%) and accidents (1%) or other reasons (Murphy et al., 2017). There has been one mass shooting (defined as incidences where four or more people are killed) per day over the past two years (Galea et al., 2018). While mass shootings, including school shootings, account for a relatively small fraction of gun related deaths and can be due to different motives, they understandably account for the majority of public awareness related to firearms.

The media, public, and political attention to firearm ownership and carriage has steadily increased and changed over the last several decades. News media coverage on gun violence tended to implicate mental illness as the cause of gun violence and frequently proposed gun restrictions for people with mental illnesses as a solution (McGinty et al., 2014). This narrative likely contributed to a general public perception that people with mental illness are the cause of gun violence and

potentially have influenced policymaking (McGinty et al., 2013). Indeed, a report analyzing state law trends in all 50 US states from 1991 to 2016 identified a significant rise in the number of states enacting laws prohibiting firearm possession by people who have been involuntarily committed for inpatient mental health treatment (Siegel et al., 2017).

Given the depiction outlined above, scholars have raised the question of "dangerous people" versus "dangerous weapons" (Gostin and Record, 2011). The dangerous people framework suggests that the group of people with mental illness should be responsible for gun violence whereas the dangerous weapons framework suggests that the responsibility is in the widespread access to guns (Swanson and Gilbert, 2011). A group of scholars (Friedman, 2006; Gostin and Record, 2011; Swanson and Gilbert, 2011) have criticized the dangerous people framework, which is frequently used in policy making, legislation, and public media, for targeting mental illness despite an overall lack of empirical evidence on its ability to predict gun violence. Scholars argue that this framework, which results in a misaligned focus on mental illness as the cause of gun violence could (1) lead to policies that restrict the rights of people with mental illness without meaningfully reducing

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gun violence (McGinty et al., 2014; Swanson and Gilbert, 2011); and (2) prevent people from seeking needed mental health treatment in fear of stigma or having their rights restricted (Gostin and Record, 2011; McGinty et al., 2014). Overall, the extant research suggests that restricting firearm access on the basis of dangerous behaviors (e.g., substance abuse, domestic violence) may reduce gun violence, whereas there is a general lack of evidence (and studies) that suggests that restricting gun ownership based on mental illness is effective (McGinty et al., 2014).

Much of the limited research on gun violence and mental illness has focused on violence among individuals with severe mental illnesses or rates of mental illness among individuals arrested for violent crimes (e.g., Bonta et al., 1998; Buckley et al., 2004; Swanson et al., 2006). However, as Friedman (2006) argued, to conclude a link between mental illness and violence based on this body of research is subject to selection bias, and the population examined is not representative of individuals with mental illness in the general population.

In recognition of the above limitation of existing research, scholars have attempted to examine the link between mental illness and gun violence in the general population (Swanson et al., 1990; Van Dorn et al., 2012). For example, using a national representative sample, Casiano and colleagues (Casiano et al., 2008) examined how mental disorders were associated with threatening others with a gun and found significant association with impulse control disorders. Overall, scholars conclude that only about 5% of violence is attributable to mental illness (Ahonen et al., 2017). However, a vast majority of these studies have relied on cross-sectional data (e.g., Casiano et al., 2008; Silver and Teasdale, 2005), thus preventing any causal inferences.

The literature is also inconsistent with how mental illness is defined. For example, Swanson et al. (2006) defined mental disorder using the Diagnostic and Statistical Manual-III criteria and found that individuals who met one or more psychiatric disorder criteria were more likely to have reported violent behavior in the prior year. Silver and Teasdale (2005) stratified individuals by severity of mental illness, including more severe (e.g., schizophrenia or major affective disorders) and less severe (e.g., phobias and somatic, panic, and eating disorders) categories. They found that only major mental disorders were significantly associated with past year violence. Casiano et al. (2008) examined mental disorder in two ways: individual mental disorders (e.g., depression, bipolar disorder, PTSD) and categories of mental disorders (i.e., any mood disorder, any anxiety disorder, and any impulse disorder). When looking at individual mental disorders and after adjusting for other disorders, only PTSD was significantly associated with threatening others with a gun. When examining by categories, only impulse disorder emerged as a significant predictor. Given the limitations of existing research, the link between gun violence and mental health remains unclear.

The present study analyzes the temporal relationships between mental health and gun violence among an ethnically diverse sample of emerging adults. This study examines gun carrying in addition to gun threatening behavior because existing research indicates that individuals in possession of a gun are over four times more likely to be shot in an assault than those not in possession (Branas et al., 2009). Thus, although gun carrying itself may not be a violent behavior, it potentially marks heightened risk among gun carriers. This study focuses on three sets of independent variables, including (1) demographic characteristics, (2) gun access and gun ownership, and (3) mental health variables.

2. Methods

2.1. Participants

Data are from an ongoing longitudinal study of 1042 participants in the southern U.S. (Temple et al., 2013) This study used Wave 6 (spring, 2015, N = 758, retention rate from Wave 5: 108.5%) and Wave 8

(spring, 2017, N = 686, retention rate from Wave 6: 90.5%) data. Notably, firearm questions of relevance were only asked at these waves (Wave 7 was an abbreviated health interview). The final sample included in analyses were 663 participants (61.7% female) who responded to the firearm questions. The sample consisted of 33.6% self-identified Hispanics, 26.0% white, 27.0% Black, and 13.4% other (i.e., Asian American, American Indian, and "other"). At Wave 8, participants had an average age of 22.05 years (*SD* = 0.77, range from 20 to 25 years).

2.2. Procedure

Researchers visited mandatory classes (e.g., English, World History) in seven public high schools in spring 2010 to recruit participants. Students were asked to participate in a study about teen health behaviors. Interested students who returned signed parental consent forms and gave assent completed paper-and-pencil surveys during regular school hours. At later assessments, participants who no longer attended the recruitment schools were provided a web link to complete the survey online. The Waves 6 and 8 data used in the present study were all collected using online surveys. Participants received compensations of $30 (electronic gift card) at each wave. The study procedure was approved by the last author's institutional review board.

2.3. Measures

Firearm possession and use. Four gun related variables were measured in this study: gun carrying (Waves 6 and 8), threatening someone with a gun (Wave 8), gun access (Wave 8), and gun ownership (Wave 8). For gun carrying, one question was asked, "within the past 12 months, about how often would you say you've carried a gun with you when you were outside your home – including in your car? DO NOT count the times you've carried a gun for hunting or target shooting". Participants reported "never", "1 time", "2 times" and up to "more than 20 times." Given the small percentages of participants endorsing different response options on the number of times (0.04%–3.5%), these responses were combined and this variable was dichotomized to yes/no for the analyses. For threatening someone with a gun, participants reported yes/no to the question "have you ever threatened someone else with a gun?" For gun access, participants responded yes/no to the question "do you have access to a gun if you needed or wanted one?" Finally, for gun ownership, participants responded yes/no to the question, "do you or does someone living in your home own a gun?" All gun related variables were treated as individual variables with a single item, thus, scale reliability cannot be calculated.

Anxiety (Wave 6). The Generalized Anxiety Disorder subscale of the Screen for Child Anxiety Related Emotional Disorders (Birmaher et al., 1999) was used to measure anxiety. Participants were asked to rate on a scale of 0 (almost never) to 2 (often) on nine items such as "I worry about how well I do things" in general situations. This scale showed good reliability (Cronbach's α = 0.92).

Depression (Wave 6). The Center for Epidemiologic Studies Short Depression Scale (Andresen et al., 1994) measured depression. Participants indicated on a scale of 1 (rarely or never) to 4 [more or all of the time (5–7 days)] on how often they experienced 10 depressive symptoms (e.g., "my sleep was restless") during the past week. The scale had acceptable reliability (Cronbach's α = 0.79).

Stress (Wave 6). The Perceived Stress Scale (Cohen et al., 1983) measured stress. Participants were asked to indicate how often in the last month they felt or thought in the ways that were described in 10 statements on a scale from 1 (= never) to 5 (= very often). The statements describe situations like "how often have you felt confident about your ability to handle your personal problems?" The scale had acceptable reliability (Cronbach's α = 0.79).

Posttraumatic stress disorder (Wave 6). PTSD was measured with the 4-item Primary Care-PTSD questionnaire (Prins et al., 2003).

Participants reported in a yes/no format whether, in the past month, they had experienced PTSD symptoms, such as having nightmares in response to lifetime traumatic events. The scale had good reliability (Cronbach's α = 0.82).

Hostility (Wave 6). The Symptom Checklist-90 (Derogatis et al., 1976) measured hostility. Participants provided their answers to the question "in general, how often do you…?" on six items such as "feel easily annoyed or irritated." The response options were on a scale from 1 (never) to 4 (most of the time). This scale had good reliability (Cronbach's α = 0.88).

Impulsivity (Wave 6) was measured with the 4-item Impulsiveness Scale from the Teen Conflict Survey (Bosworth and Espelage, 1995). Participants reported on a scale of 1 (never) to 5 (always) to items such as "I do things without thinking". The scale had acceptable reliability (Cronbach's α = 0.79).

Borderline personality disorder (Wave 6) was measured with the Borderline Personality Features Scale for Children (Crick et al., 2005). Participants responded on a scale of 1 (not at all true) to 5 (always true) to 24 items such as "I change my mind almost every day about what I should do when I grow up." The scale had good reliability (Cronbach's α = 0.87).

Mental health treatment (Wave 8). Participants responded yes/no to the question "have you received mental health treatment/counseling in the past year from a psychologist, psychiatrist, social worker, or counselor?"

Demographic variables. Age, gender, and race information were collected at baseline. At Wave 8, participants were asked about their current life situations, including whether they were "attending college/trade school (even if working)", "working (not in school)" or "not in school and not working."

2.4. Data analysis

Data analyses were performed using SPSS 24 (IBM Corporation, 2016). Preliminary analyses were carried out to examine variable means, frequencies, and correlations. For all mental health variables, the scale means were used for the analysis. First, to examine the two dependent variables, gun carrying (Wave 8) and threatening others with a gun (Wave 8) by demographic characteristics, a series of logistic regressions were carried out. Next, multivariate logistic regression tests (Models 1–4) were conducted to predict the two dependent variables. All models controlled for age, gender, race, and current life situation. In additional, school cluster standard errors were adjusted for by including six dummy-coded school variables (i.e., 1 = students in school X and 0 = students in all other schools; 1 = students in school Y and 0 = students in all other schools; and so forth). Model 1 examined whether gun access and gun ownership, both at Wave 8, predicted the two dependent variables after controlling for the aforementioned demographic and school variables. Model 2 tested whether prior year mental health treatment (Wave 8) associated with the dependent variables after controlling for demographics and school factors. Model 3 examined the associations of the seven mental health variables (i.e., anxiety, depression, stress, PTSD, hostility, impulsivity, and borderline personality disorder) at Wave 6, after controlling for mental health treatment, demographic, and school variables. Finally, Model 4 examined the associations including all gun variables, mental health variables, demographic and school variables in the same model.

3. Results

Table 1 presents variable means, frequencies, and bivariate correlations. As shown in Table 2, univariate logistic regression results indicated that gun carrying and threatening someone with a gun did not differ based on age, gender, race, and current life situations. However, based on multivariate logistic regression analyses, when other demographic characteristics were controlled, males were 3.04 times (95% CI:

1.06, 8.73) more likely to have threatened someone with a gun compared to their female counterparts.

As shown in Table 3, Wave 8 gun carrying was significantly associated with gun access (Wave 8), gun ownership (Wave 8), and impulsivity (Wave 6) once we controlled for other factors (Model 4). Specifically, those who had access to a gun at Wave 8 were 4.74 times (95% CI: 2.01, 11.16) more likely to carry a gun outside of their home at Wave 8. Those who reported owning a gun at Wave 8 were 5.22 times (95% CI: 2.31, 11.77) more likely to carry a gun outside of their home at Wave 8. A temporal association was identified for impulsivity in that those who reported higher impulsivity at Wave 6 were 1.91 times (95% CI: 1.25, 2.93) more likely to carry a gun at Wave 8. Other mental health variables, including anxiety, stress, depression, PTSD, hostility, and borderline personality disorder did not show significant temporal associations with gun carrying once prior gun carrying, demographics, other gun-related variables and prior mental health treatment were controlled for.

As shown in Table 4, having received past-year mental health treatment at Wave 8 significantly predicted threatening someone with a gun at Wave 8 after controlling for demographic characteristics (Model 2; adjusted odds ratio = 3.68, 95% CI: 1.17, 11.54). However, when other mental health variables were included in the model, the association became non-significant (Model 3; adjusted odds ratio = 3.28, 95% CI: 0.89, 12.12). Overall, after controlling for demographic characteristics and other factors (Model 4), these who had access to a gun were 18.15 times (95% CI: 2.52, 130.48) more likely to have threatened someone with a gun. A temporal association was identified for hostility (Wave 6) in that those who had a hostile demeanor were 3.51 times (95% CI: 1.27, 9.71) more likely to have threatened someone with a gun (Wave 8) even after controlling for demographic, gun-related variables, prior mental health treatment and other mental health variables.

4. Discussion

Using a large, racially diverse sample of emerging adults, this study examined the temporal link between mental health symptoms and gun violence (i.e., gun carrying and threatening someone with a gun). Notable in the findings was that most mental health symptoms were unrelated to gun violence. Indeed, after controlling for gun-related and demographic variables, only hostility significantly predicted having threatened someone with a gun. While hostility is a characteristic of some mental health problems (e.g., oppositional defiant disorder, Hamilton and Armando, 2008; schizophrenic spectrum disorders, Lysaker et al., 2002), it could also be a characteristic of general personality demeanor as opposed to representative of mental illness, per se. By definition, hostility is a cognitive trait that represents "a devaluation of the worth and motives of others, an expectation that others are likely sources of wrongdoing, a relational view of being in opposition toward others, and a desire to inflict harm or see others harmed" (Smith, 1994, p. 26). Research has suggested that hostility and angry affect, a consequence of hostile cognitions (Eckhardt et al., 2004), is often linked to aggression and violence (Norlander and Eckhardt, 2005; Wilkowski and Robinson, 2010). To potentially reduce the risk of gun violence, programs that promote mindfulness and cognitive control, strategies that have shown to reduce anger and hostility (Borders et al., 2010; Wilkowski et al., 2010), may be helpful.

Interestingly, impulsivity did not significantly predict threatening someone with a gun, contrary to prior research (Casiano et al., 2008). This inconsistency may be due to how impulsivity is defined. Casiano and colleagues examined "any impulsive disorder" whereas this study asked about specific impulsive behaviors. Other mental health symptoms, including depression, anxiety, stress, PTSD, and borderline personality disorder did not significantly predict threatening someone with a gun. Although the non-significant finding of anxiety is consistent with prior research (Swanson, 1994), the findings of depression and PTSD

Table 1
Construct frequency, mean, and bivariate correlations.

	Frequency (%)/M (SD)	Scale range	1	2	3	4	5	6	7	8	9	10	11
1. Gun carrying W8	95 (9.1%)	Yes/no	1.00										
2. Threatening someone with a gun W8	16 (1.5%)	Yes/no	0.22[b]	1.00									
3. Gun access W8	274 (26.3%)	Yes/no	0.40[b]	0.15[b]	1.00								
4. Gun ownership W8	249 (23.9%)	Yes/no	0.41[b]	0.10[b]	0.65[b]	1.00							
5. Mental health treatment W8	92 (13.9%)	Yes/no	−0.00	0.08[a]	−0.04	−0.04	1.00						
6. Anxiety W6	0.91 (0.59)	0–2	−0.07	0.02	−0.09[a]	−0.02	0.14[b]	1.00					
7. Depression W6	1.88 (0.54)	1–4	−0.07	0.03	−0.09[a]	−0.07	0.16[b]	0.58[b]	1.00				
8. Stress W6	1.67 (0.68)	0–4	−0.05	0.03	−0.12[b]	−0.07	0.11[b]	0.55[b]	0.73[b]	1.00			
9. PTSD W6	0.24 (0.34)	0–1	−0.04	−0.01	−0.02	−0.08	0.15[b]	0.33[b]	0.49[b]	0.42[b]	1.00		
10. Hostility W6	1.69 (0.60)	1–4	0.03	0.14[b]	−0.04	−0.05	0.16[b]	0.29[b]	0.39[b]	0.42[b]	0.28[b]	1.00	
11. Impulsivity W6	2.24 (0.89)	1–5	0.10[a]	0.02	0.01	−0.01	0.14[b]	0.43[b]	0.48[b]	0.41[b]	0.38[b]	0.39[b]	1.00
12. Borderline personality disorder W6	2.26 (0.58)	1–5	−0.02	0.06	−0.10[a]	−0.10[a]	0.09[a]	0.39[b]	0.53[b]	0.50[b]	0.42[b]	0.46[b]	0.48[b]

[a] Correlation is significant at the 0.05 level (2-tailed).
[b] Correlation is significant at the 0.01 level (2-tailed).

are counter to expectation (Arseneault et al., 2000; Freeman et al., 2003). One possible reason is that participants who report symptoms of a mental disorder (e.g., depression) do not necessarily reach criteria to be diagnosed (e.g., with major depression). It is also possible that individuals with severe mental illnesses are not violent unless they have a comorbid substance use disorder or a history of violence (Gostin and Record, 2011). Overall, the findings highlight the importance of examining different types of mental illness and symptoms and their specific associations with gun violence.

Prior gun carrying, having access to a gun, and owning a gun were all linked to future gun carrying. Although gun carrying itself is not a violent behavior, research has demonstrated a strong link between this behavior and gun violence victimization (Branas et al., 2009). The finding has important implications for states and campuses considering open carry laws – while these policies may be intended to increase safety, they may have the unintended result of increasing gun violence victimization. Among mental health variables, only impulsivity was identified as a significant predictor of gun carrying. Research has suggested that impulsivity is associated with a host of risk behaviors, including suicide attempts and drug abuse (Bakhshani, 2014). That impulsivity is related to gun carrying does not necessarily make it dangerous, given the varied reasons individuals choose to carry. Indeed, when asked about the reasons for gun carrying, among the 91 participants who provided an answer, 80 (88%) reported that it was because they needed protection or to feel safe. This finding suggests that the best method to preventing gun carrying may be the building of an overall safer environment.

This study found that individuals who had access to guns, compared to those with no such access, were over 18 times more likely to have threatened someone with a gun, even after controlling for a number of demographic and mental health variables. Research has shown that areas or states in the US with higher gun ownership rates had higher firearm homicide rates (Miller et al., 2002; Siegel et al., 2013) indicating an expected link between gun access and gun violence. This finding extends this knowledge by providing evidence for the link between gun access and gun violence on an individual level. While an argument can be made that threating someone with a gun does not necessarily equal gun violence, it is an adequate proxy or precursor to actual gun violence. Taken together, limiting access to firearms, regardless of demographic characteristics, mental health status, and prior mental health treatment, would likely reduce threats made with a gun and gun violence.

Counter to the limited prior research (Casiano et al., 2008), age, race, and current life situation was not significantly linked to gun carrying or threatening someone with a gun. It is possible that the study sample was relatively homogeneous (i.e., emerging adults in similar life situations) and thus potential differences cannot be identified. Notably, males were 3.04 times more likely to have threatened someone with a gun after controlling for other demographic factors. This finding is consistent with prior research (Swanson, 1994; Van Dorn et al., 2012) and highlight the importance of targeted intervention for males.

Table 2
Gun carrying and threatening someone with a gun by demographics.

	Gun carrying				Threatening someone with a gun			
	Yes (n = 95) n (%)	No (n = 568) n (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Yes (n = 16) n (%)	No (n = 647) n (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age			0.83 (0.63, 1.11)	0.84 (0.60, 1.16)			92 (0.48, 1.76)	0.76 (0.38, 1.53)
Gender								
Female	53 (55.8)	356 (62.7)		1.00	6 (37.5)	403 (62.3)		1.00
Male	42 (44.2)	212 (37.3)	1.33 (0.86, 2.06)	1.53 (0.96, 2.44)	10 (62.5)	244 (37.7)	2.75 (0.99, 7.67)	3.04 (1.06, 8.73)
Race								
White	31 (32.6)	141 (24.8)		1.00	5 (31.2)	167 (25.9)		1.00
Hispanic	30 (31.6)	193 (34.0)	0.71 (0.41, 1.22)	1.31 (0.70, 2.45)	3 (18.8)	220 (34.0)	0.46 (0.11, 1.93)	0.47 (0.10, 2.17)
Black	24 (25.3)	155 (27.3)	0.70 (0.39, 1.26)	1.80 (0.84, 3.86)	4 (25.0)	175 (27.0)	0.76 (0.20, 2.89)	0.69 (0.13, 3.85)
Other	10 (10.5)	79 (13.9)	0.58 (0.27, 1.24)	1.01 (0.44, 2.34)	4 (25.0)	85 (13.1%)	1.57 (0.41, 6.00)	1.67 (0.39, 7.24)
Current situation								
At school	41 (43.2)	295 (51.9)		1.00	5 (31.3)	331 (51.2)		1.00
Working	47 (49.5)	237 (41.7)	1.43 (0.91, 2.24)	1.18 (0.72, 1.92)	10 (62.5)	274 (42.3)	2.42 (0.82, 7.15)	2.84 (0.88, 9.17)
Not at school or working	7 (7.4)	36 (6.3)	1.40 (0.58, 3.35)	1.36 (0.54, 3.44)	1 (6.3)	43 (6.5)	1.58 (0.18, 13.82)	1.66 (0.17, 15.90)

Notes. OR = odds ratio, CI = confidence interval. Unadjusted OR are based on univariate logistic regression, adjusted OR are based on multivariate logistic regression controlling for other demographic characteristics.

Table 3
Multivariate logistic regression of gun carrying.

	Model 1 AOR (95% CI)	Model 2 AOR (95% CI)	Model 3 AOR (95% CI)	Model 4 AOR (95% CI)
Gun Access W8	4.61 (2.00, 10.64)			4.74 (2.01, 11.16)
Gun Ownership W8	4.64 (2.12, 10.16)			5.22 (2.31, 11.77)
MH Treatment W8		1.11 (0.57, 2.16)	1.32 (0.63, 2.73)	1.11 (0.44, 2.84)
Anxiety W6			0.68 (0.39, 1.19)	0.58 (0.30, 1.12)
Depression W6			0.63 (0.30, 1.33)	0.50 (0.21, 1.18)
Stress W6			1.13 (0.64, 1.98)	1.51 (0.78, 2.90)
PTSD W6			0.79 (0.33, 1.90)	0.70 (0.25, 1.93)
Hostility W6			1.12 (0.70, 1.80)	1.11 (0.62, 2.00)
Impulsivity W6			1.68 (1.18, 2.38)	1.91 (1.25, 2.93)
BPD W6			0.82 (0.46, 1.47)	0.92 (0.47, 1.83)

Note. Results were adjusted for Wave 6 gun carrying, age, gender, race, current situation, and school cluster standard errors. AOR = adjusted odds ratio, CI = confidence interval. MH Treatment = prior year mental health treatment, BPD = borderline personality disorder, W6 = Wave 6, W8 = Wave 8.

Table 4
Multivariate logistic regression of threatening someone with a gun.

	Model 1 AOR (95% CI)	Model 2 AOR (95% CI)	Model 3 AOR (95% CI)	Model 4 AOR (95% CI)
Gun Access W8	11.89 (1.98, 71.33)			18.15 (2.52, 130.48)
Gun Ownership W8	1.06 (0.29, 3.81)			1.32 (0.30, 5.77)
MH Treatment W8		3.68 (1.17, 11.54)	3.28 (0.89, 12.12)	3.99 (0.81, 19.61)
Anxiety W6			1.44 (0.45, 4.67)	1.67 (0.44, 6.40)
Depression W6			1.00 (0.21, 4.65)	1.12 (0.20, 6.28)
Stress W6			1.05 (0.31, 3.54)	1.42 (0.37, 5.41)
PTSD W6			0.45 (0.07, 2.76)	0.26 (0.04, 1.97)
Hostility W6			3.52 (1.56, 7.95)	3.51 (1.27, 9.71)
Impulsivity W6			0.56 (0.26, 1.22)	0.50 (0.21, 1.23)
BPD W6			1.50 (0.52, 4.27)	2.12 (0.71, 6.31)

Note. Results were adjusted for age, gender, race, current situation, and school cluster standard errors. AOR = adjusted odds ratio, CI = confidence interval. MH Treatment = prior year mental health treatment, BPD = borderline personality disorder, W6 = Wave 6, W8 = Wave 8.

4.1. Limitations

Several limitations should be noted. First, this study examined the link between gun violence and mental health in a sample of emerging adults. The generalizability of the findings to other age groups must be done with caution. Second, a small portion of the participants (n = 16, 1.5%) reported having threatened someone with a gun, which introduces potential bias of analysis. However, the fact that this study was able to identify statistically significant findings with such a small sample highlights the strong associations and is by itself noteworthy. Third, the study used self-report measures of mental health symptoms and do not represent actual diagnoses. Fourth, the included mental health symptoms were by no means exhaustive; other more serious symptoms (e.g., hallucinations) and mental disorders (e.g., schizophrenia) were excluded in the survey. Fifth, this study only focused on gun access and mental health symptoms. Other factors, such as substance misuse, which has a known link to gun violence (Friedman, 2006), was out of the study scope but should be examined in future research.

5. Conclusion

To the best of the authors' knowledge, this is the first study to examine the temporal association between gun violence and mental health symptoms. Despite the public, political, and media narrative that mental health is at the root of gun violence (especially mass shootings, McGinty et al., 2014), this study did not find it to be the case. Indeed, of all the mental health symptoms considered, only impulsivity was associated with gun carrying and only hostility was associated with threatening someone with a gun. A strength of the present study is that it examined the joint effects of gun access and mental health and found that access to guns was especially strong in predicting gun carrying and

threatening someone with a gun, even after controlling for demographic characteristics, prior mental health treatment, and mental health symptoms. This finding has important implications for gun control policy efforts.

Conflict of interests

The authors declare that there are no conflicts of interest.

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