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Beyond the trigger: The mental health consequences of in-home firearm access among children of gun owners

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Abstract

Rationale—The high prevalence of household firearms in the U.S. has ignited a growing body of research seeking to understand its health consequences. While a large number of studies examine the impact of firearm availability on health risks of gun owners in the household, relatively little attention is given to whether and how in-home firearm access may shape psychological outcomes among children of gun owners.

Objective—This study examined whether and how in-home firearm access is associated with adolescents' depressive symptoms. Given a strong social/cultural association between masculinity and gun possession as well as stark gender differences in perceptions of safety and attitudes toward firearms, this study also investigated whether this association differs for male and female adolescents.

Methods—Participants were drawn from the National Longitudinal Study of Adolescent to Adult Health (Add Health) ($n = 14,013$). This study used random- and fixed-effects regression analyses as well as propensity-score matching models in order to reduce the chances of bias due to individual-level heterogeneity.

Results—The present study showed that gaining access to guns at home was significantly related to increased depressive symptoms among children of gun owners, even after accounting for both observed and unobserved individual characteristics. Both fixed-effects and propensity-score matching models yielded consistent results. In addition, the observed association between in-home firearm access and depression was more pronounced for female adolescents. Finally, this study found suggestive evidence that the perceptions of safety, especially about school (but not neighborhood), are an important mechanism linking in-home firearm access to adolescent depression.

Conclusion—As a substantial proportion of U.S. adolescents reported in-home firearm access, the findings of this study suggest that scholars and policymakers must seriously consider mental as well as physical health consequences related to household access to firearms among children of gun owners.

Keywords

Firearms; Guns; Adolescents; Mental health; Depression; Safety perceptions

1. Introduction

In-home firearm access among children and adolescents has become widespread in the United States (Anglemyer et al., 2014; Grossman et al., 2005; Simonetti et al., 2015). American adolescents in recent years, having grown up with the highest gun ownership rate in the world (Small Arms Survey, 2007), are more likely to have access to firearms at home compared to adolescents in any other country. One third of U.S. households with children under the age of 18 was reported to have firearms (Johnson et al., 2004), and about 40 percent of adolescents living in a household with a firearm reported easy access to guns at home (Simonetti et al., 2015). Strikingly, one fifth of gun owners with children under 18 store a gun loaded, more than one third store one unlocked, and nearly 1 in 10 store a gun loaded and unlocked (Johnson et al., 2006, 2004).

With the highest rates of private firearm ownership in the U.S, a burgeoning literature has sought to understand the health-related consequences of firearm availability (e.g., Hemenway, 2011). Literature consistently shows that firearm ownership increases the risk of homicide (Hepburn and Hemenway, 2004; Miller et al., 2007) and suicide (Florentine and Crane, 2010; Miller et al., 2013; Rivara, 2015), as well as firearm-related accidents (Miller et al., 2005). While prior research examines physical health consequences of firearm availability, scholars have given little attention to whether firearm availability has psychological effects, especially on children of gun owners. Although the vast majority of gun owners say that the main reason they own a gun is to protect their homes and families (Azrael et al., 2017; Hemenway, 2011), and that having a gun makes them feel safer (Pew Research Center, 2013), prior research on perceptions of safety and attitudes toward firearms among adolescents rather suggest that in-home firearm access may be detrimental to adolescent mental health. In this study, I examine whether and how in-home firearm access affects the psychological well-being of the children of gun owners.

Using data from the National Longitudinal Study of Adolescent to Adult Health (Add Health), this study examines whether in-home firearm access is related to depressive symptoms among children of gun owners. In order to assess the causal nature of these associations, this study relies on fixed-effects models to estimate change in depressive symptoms as a function of change in in-home firearm access over the course of approximately 1 year. The fixed effects models exploit the longitudinal nature of the data to control for preexisting, stable individual differences, for example, temperament/disposition or parenting styles that may influence both in-home firearm access and adolescent depression. As an alternative way of minimizing selection, propensity score matching analyses that create experiment-like conditions are also conducted. Given a strong social/cultural association between masculinity and gun possession (Hill et al., 1985; Stroud, 2012) as well as stark gender differences in perceptions of safety and attitudes toward firearms (Miller et al., 2000; Patten et al., 2013; Pew Research Center, 2013), I argue that psychological health consequences related to in-home gun access among children of gun owners may differ by gender. Finally, this study considers shifts in perceptions of safety among children of gun owners as a plausible mechanism that links in-home firearm access to depressive symptoms.

2. Background

2.1. Gun ownership and health

The United States is the most heavily armed society in the world, with about 90 guns for every 100 residents (Karp, 2011). As of 2015, there were approximately 265 million guns in the U.S. civilian gun stock, an increase of about seventy million guns since the mid-1990s (Azrael et al., 2017). Several surveys including the 2015 National Firearms Survey (NFS) and the General Social Survey (GSS) survey have reported that in 2015 about 22 percent of U.S. adults personally owned a gun, and they tend to have more guns than in 1994 (the average number of guns increased from four to five) (Azrael et al., 2017; Smith and Son, 2015). According to the General Social Surveys (GSS) data, despite declining rates of household ownership of firearms, about 31 percent of households reported having a gun in 2010–2014 (Smith and Son, 2015). Men are far more likely to personally own a gun compared to women, though the gender gap has narrowed due to a reduction in personal gun ownership among men: In 2014, 35.1 percent of men and 11.7 percent of women reported that they personally own firearms. There are also racial/ethnic differences in firearm ownership. More households with white respondents (39.0 percent) own guns than those with black respondents (18.1 percent), and similarly, household firearms ownership is higher among non-Hispanics (36.0 percent) than among Hispanics (15.2 percent).

Why do people own guns? A national survey finds that nearly half of gun owners reported self-defense as the main reason for owning their gun; approximately 30 percent of respondents say they own a firearm for the purpose of hunting, and even fewer respondents cite other reasons such as target/sport shooting (7 percent) and gun collecting (2 percent) (Pew Research Center, 2013). While the possible health benefits of gun availability are potentially twofold: (1) deterring crime and (2) stopping crimes in progress, there is no credible evidence to support either (see Hemenway, 2011; for a review). Rather, a large amount of epidemiological evidence documents the health risks of in-home firearm availability.

Gun ownership is the strongest risk factor of homicide in the home, even after accounting for other potential confounding factors such as drug use, history of violence, criminal record, and so on (Cook and Ludwig, 2006; Hepburn and Hemenway, 2004). Moreover, a large body of research suggests that firearm availability plays a leading role in increasing suicide risk (Miller et al., 2013; Rivara, 2015). A recent meta-analysis found that firearm availability was associated with higher odds of committing suicide, with odds ratios ranging from 1.38 to 10.38 (Anglemyer et al., 2014). One unintended cost of gun ownership is increased risk of accidents, including fatal ones (Miller et al., 2005). Each year in the U.S. there are about 19,000 gun accidents, and about 600 of these are fatal. From 2005 to 2010, almost 3800 people in the U.S. died from unintentional shootings (the deaths of 606 people in 2010), and more than a third of the victims were under 25 years of age (New Yorkers Against Gun Violence, 2013).

2.2. Psychological consequences of in-home firearm access

While far more today than in the past cite self-protection as the main reason they own guns and the vast majority of gun owners believe that having a gun makes them feel safer (Hemenway et al., 1995; Pew Research Center, 2013), little research establishes that gun ownership leads to reduced fear or concern over safety (e.g., Azrael and Hemenway, 2000). One of the main reasons for lack of evidence on the effects of gun ownership on psychological outcomes such as perceived safety and fear is due to methodological complexities in the relationship (e.g., endogeneity of gun ownership) (Hauser and Kleck, 2013). The correlation between gun ownership and psychological outcomes may be spurious, due to individual-level heterogeneity (attributes of individuals that select for both measures). Moreover, it is hard to establish the causal ordering of two measures since psychological characteristics can serve as both a cause and a consequence of gun ownership (the possibility of reverse causality). A recent work by Hauser and Kleck (2013) has attempted to address these methodological challenges by using a longitudinal model. The authors found that gun acquisition does not have an effect on reduction in fear of crime, but the loss of a household gun increases fear of crime. As acknowledged by the authors, however, due to the data limitations of a sizable attrition (46 percent attrition) and severe regional restrictions in the sample (a single state), the findings of the study should be interpreted cautiously.

Gun ownership may have psychological effects, not only for those possessing guns, but for those without guns as well (Patten et al., 2013; Pew Research Center, 2013). Studies suggest that gun ownership in one household reduces the perception of safety among members of other households (i.e., a perceived negative externality) (Hemenway, 2001; Miller et al., 2000). A survey of over 2500 randomly selected adults shows that half the respondents reported that they would feel less safe if more people in their community were to own guns; 14 percent reported they would feel more safe. Even in gun-owning households, the perceptions of safety and enjoyment from having a gun were much lower among those aged 18 years and over who do not personally own guns than gun owners (Pew Research Center, 2013).

To the author's knowledge, no research has examined the psychological consequences of in-home firearm access for children of gun owners. With widespread access to guns at home among American adolescents (Simonetti et al., 2015), it is critical to examine how firearm availability at home can influence children's psychological outcomes such as depression. Gaining access to household firearms may decrease children's psychological well-being through several mechanisms. One possible explanation may be that children with access to firearms in their home show lower levels of psychological well-being due to increased concerns about possible firearm-related accidents (Pew Research Center, 2013). This proposition can be corroborated by the fact that most accidental gun injuries to children happen in home, and most unintentional gun fatalities are other-inflicted, with the shooter overwhelmingly likely to be a friend or young family member, such as an older sibling (Hemenway et al., 2010; Papachristos et al., 2015).

Another plausible pathway that links in-home firearm access to psychological outcomes among children of gun owners is perceptions of safety. Children who gain access to firearms

at home may feel less safe in their surroundings (e.g., neighborhood and school) because they may think that more people around them, such as neighbors and school peers, are also likely to have access to guns. In other words, in-home firearm access may increase their perceived prevalence of gun ownership in a community or a school, which in turn makes them feel less safe (e.g., concern about gun crime and violence, gun accidents, and school shooting). A majority of young students appear to be more averse to living alongside guns, especially in the school setting (Cavanaugh et al., 2012; Thompson et al., 2013; Wolfson et al., 2017): for example, a survey shows that the majority of college students (about 80 percent) reported that most students would not feel safe if more people (faculty, students, and visitors) carried concealed handguns on campus. It is well established that the perceptions of safety in neighborhoods and schools are associated with psychological outcomes such as depressive symptoms and suicidal thoughts (Borowsky et al., 2013; Hamada et al., 2016; Kohoulat et al., 2015).

In light of these arguments, my first hypothesis is that in-home firearm access will lead to higher levels of depressive symptoms for children of gun owners (H1). My second hypothesis, associated with examination of potential mechanisms, in-home firearm access will lead to lower levels of perceived neighborhood and school safety (H2).

2.3. Gender perspectives

Research shows that the prevalence of gun ownership substantially differs by gender: in 2014, it was 35.1 percent for men and 11.7 percent for women for a gender gap of 23.4 points (Smith and Son, 2015). Gender differences are not only limited to actual ownership, but also are present in the perceptions and attitudes toward firearms. Women tend to report a greater perception of danger as well as fear (Harris and Miller, 2000), appear more inclined to describe firearms as a threat to safety (Patten et al., 2013; Pew Research Center, 2013), and show lower levels of attraction to gun ownership and use compared to men (Shapiro et al., 1998). Fear of crime and previous victimization increase protective handgun ownership only for men, suggesting that women do not believe that gun ownership can reduce their fears of crime and victimization (Hill et al., 1985). Using the samples drawn from college students, Blair and Hyatt (1995) also showed that women were more likely to fear guns and be more hesitant to use guns if necessary.

Some research documents gender differences in the relationship between acquisition of firearms by others and the perceptions of safety. Miller et al. (2000) found that women were more likely than men to feel unsafe as others acquire guns. Similarly, Patten et al. (2013) also found that women have a strong tendency to feel less safe with more guns on campus and reject firearms, even in the aftermath of campus crimes. This evidence is consistent with women's support for stricter gun control policies (Miller et al., 2000; Pew Research Center, 2013). These gender differences in perceptions of safety and attitudes toward firearms suggest that there may be a greater reduction in psychological well-being among female adolescents with in-home firearm access than their male counterparts. In contrast, increased firearm availability may exert a countervailing influence on male adolescents' psychological well-being, particularly when they believe that household firearms provide them with protection against crime, which makes them feel safer.

In light of these arguments, I hypothesize that the detrimental effects of in-home firearm on depression and perceived safety will be more pronounced among female adolescents than male adolescents (H3).

3. Methods

3.1. Data

The data used in this study come from the restricted version of Add Health, which is a school-based, longitudinal study of the health-related behaviors of adolescents and their outcomes in young adulthood. Beginning with an In-School questionnaire administered to a nationally representative sample of students in grades 7 through 12 in 1994–1995, the study follows up with a series of In-Home interviews of students approximately one year, six years, and thirteen years later. Other sources of data include questionnaires for parents, siblings, fellow students, and school administrators. By design, the Add Health survey includes a sample stratified by region, urbanicity, school type, ethnic mix, and size.

The present study uses the first two waves (Wave 1 and Wave 2) of the In-Home Survey. Of the 20,745 individuals who completed the Wave 1 survey, approximately 18,600 adolescents in grades 7 through 11 in Wave 1 (plus 12th graders who were part of the genetic sample and the adopted sample) were eligible to be followed up at Wave 2. Of the 18,600 adolescents, 14,736 students were followed longitudinally at Wave 2, leading to the response rate of about 79%. In the fixed-effects models, I lost 723 (5 percent) with missing data on in-home firearm access, depressive symptoms, or time-varying control variables at Wave 1 or 2. In order to construct the same sample for fixed-effects models, following recommended analytic practices (Allison, 2002), I employed multiple imputation to handle missing values in Wave 1 time-invariant control variables such as standardized PVT score, mother's education level, and family income (about 20 percent missing data). Using the chain equations (ICE) procedure in STATA 14, I performed ten imputations to predict missing values (Royston, 2004), and did not impute missing values on dependent variables (von Hippel, 2007). The total sample size of the full sample is 14,013 (7183 females and 6830 males).

3.2. Measures

The main dependent variable of this study is a measure of depressive symptoms, which was based on a 19-item self-report measure of the Center for Epidemiological Studies Depression Scale (CES-D) (Meier, 2007). The CES-D assesses respondents' feelings, thoughts, and physical conditions during the past week. A detailed description of the questions is presented in Tables A1 in Supplementary Data. Each question had four response categories: 0 = never or rarely; 1 = sometimes; 2 = a lot of the time; and 3 = most of the time or all of the time. The mean of the responses to these 19 items served as the final scale (Cronbach's alpha = 0.87). Other dependent variables include perceived neighborhood safety and perceived school safety. The perceptions of neighborhood safety were measured by respondents' report on whether or not they usually feel safe in their neighborhood. The perceptions of school safety were measured by respondents' report on how much they agree or disagree with the following statement (1 = strongly disagree; 2 = disagree; 3 = neither

agree nor disagree; 4 = agree; and 5 = strongly agree): “Since the start of the school year, you feel safe in your school.”

In supplementary analyses, I use two additional outcome measures related to perceived neighborhood safety: perceived neighborhood connection and satisfaction with neighborhood. Respondents reported whether or not they agreed (1 = yes; 0 = no) with three statements about their neighborhoods: “You know most of the people in your neighborhood;” “In the past month, you have stopped on the street to talk with someone who lives in your neighborhood;” and “People in this neighborhood lookout for each other.” The dichotomous items were summed to form a scale on which higher values represent higher levels of perceived neighborhood connection (Wright and Fitzpatrick, 2006; Zimmerman et al., 2016). Finally, the measure of satisfaction with neighborhood was based on respondents’ report on the following question (1 = not at all; 2 = very little; 3 = somewhat; 4 = quite a bit; and 5 = very much): “On the whole, how happy are you with living in your neighborhood?”

The key independent variable is in-home firearm access, which was based on respondents’ report on whether or not a gun is easily available to them in their home. This question was asked for both Wave 1 and Wave 2 of In-Home survey. Time-constant control variables include gender, age, race/ethnicity (non-Hispanic White, Black, Hispanic ethnicity, and others), grade level, ability test scores (measured by the standardized Peabody Picture Vocabulary Test [PVT]), mother’s education, and family income. Time-varying control variables include self-reported health status, self-reported GPA, rural status, family suicide attempts, and friend suicide attempts.

3.3. Analytic strategy

This study uses fixed-effects models to examine the relationship between in-home firearm access and depressive symptoms for the children of gun owners. I begin with a general model for panel data:

$$Y_{it} = \alpha_t + \beta \text{GunAccess}_{it} + X_i\gamma + Z_{it}\delta + \nu_i + \varepsilon_{it} \quad (1)$$

In this equation, Y_{it} is the dependent variable, depressive symptoms (and perceived safety), at time t for individual i , α_t is the intercept at time t , β is the coefficient for the key independent variable, i.e., in-home firearm access. γ is the vector of coefficients for all time-constant characteristics, and δ is the vector of coefficients for all time-varying characteristics. ν_i is the individual-specific, time-invariant error term, and ε_{it} is the idiosyncratic error term that is time varying. In general, there are two common ways to estimate the above longitudinal model: random- and fixed-effects regression models. These two models handle the constant and unobserved individual-specific effects differently. Fixed effects models treat ν_i as fixed constants and omit all between-person variance from the model, whereas random effects models view ν_i as drawn from a random variable with constant variance that can be estimated from the data.

The random-effects assumption that ν_i is uncorrelated with the measured variables that are included in the model and of ε_{it} , however, is often unwarranted in observational studies (Vaisey and Miles, 2017). Fixed effects model is thus less prone to bias due to its more realistic assumptions about observed and unobserved heterogeneity (Firebaugh et al., 2013). While the random-effects models benefit from smaller variability (and thus narrower confidence intervals) and the possibility of estimating both time-constant and time-varying variables, it is more vulnerable to omitted variable bias from time-invariant unobserved heterogeneity (Allison, 2009; Winship and Morgan, 1999). For this study, fixed effects models may be preferable over random effects models since it is likely that there are various sources of (time-invariant) unobserved heterogeneity that may jointly determine firearm availability and depressive symptoms.

The following equation, where the vector of time-constant characteristics, $X_i\gamma$, is removed from Eq. (1) represents the fixed-effects model:

$$Y_{it} = \alpha_t + \beta \text{GunAccess}_{it} + Z_{it}\delta + \nu_i + \varepsilon_{it} \quad (2)$$

In order to estimate the above model, I use time-varying measures at Waves 1 and 2 and estimate first-difference models, which are equivalent to fixed effects models in the two-wave panel data. This fixed effects approach regresses change in depressive symptoms between Waves 1 and 2 onto change in in-home firearm access between Waves 1 and 2. This model can be represented with the following equation:

$$Y_{i2} - Y_{i1} = (\alpha_2 - \alpha_1) + \beta(\text{GunAccess}_{i2} - \text{GunAccess}_{i1}) + (Z_{i2} - Z_{i1})\delta + (\varepsilon_{i2} - \varepsilon_{i1}) \quad (3)$$

Since the fixed-effects model cannot rule out the possibility of potential bias arising from time-varying unobserved individual heterogeneity, I control for changes in potential time-varying confounding factors. δ represents a vector of coefficients for these time-varying control variables. Finally, in order to examine whether the effects of firearm accessibility on depression (and perceived safety) vary by gender, the interaction term between firearm accessibility and a female indicator is added.

I estimate both fixed- and random-effects models, and conduct the Hausman test (Halaby, 2004; Hausman, 1978) to determine if there is sufficient evidence to reject the null hypothesis that the unobserved person-specific differences are orthogonal to the regressors in the model (i.e., the random-effects assumption). If we reject the null hypothesis, then we conclude that the unobserved heterogeneity is correlated with the regressors, and thus that the random effects estimates are not consistent. Results from the Hausman test suggest that the random effects models should be rejected in favor of the fixed effects model. Therefore, my interpretation relies primarily on fixed-effects estimates and uses the fixed effects models for further analyses, though random-effects results are substantially similar. For the purpose of comparison, I present the random-effects results as well (only for models with depressive symptoms as an outcome).

In this study, propensity score matching analyses, as an alternative way of minimizing selection, are also conducted. Heckman et al. (1998) demonstrated that propensity score matching models can potentially address biases that may result in estimating of a treatment effect between individuals who are not directly comparable. Propensity score matching is a useful tool to balance measured covariates between treatment and comparison groups, and better approximate the conditions of an experiment (i.e., random assignment to firearm accessibility). Specifically, by using only individuals who did not have access to guns at home by Wave 1, I compare those with access to guns at home at Wave 2 (the “treatment” group) and without access at Wave 2 (the “control” group) who are as similar as possible on observed characteristics at both individual- and family-level.

First, in order to construct a propensity score (i.e., the conditional probability of gaining access to firearms at home by Wave 2), I use a rich set of observed covariates that confound the relationship between “treatment” and the outcome or that predict the outcome (Garrido et al., 2014). The variables used for matching include the Wave 1 outcome measure (e.g., Wave 1 depressive symptoms), all time-constant and time-varying control variables used in the longitudinal models, as well as the following additional set of variables: living arrangement, religious attendance, maternal emotional support, closeness to mother, maternal involvement, maternal employment, and friends’ emotional support. Summary statistics for these variables are presented in Table A2 in Supplementary Data. Following Hill’s (2004) multiple imputation matching strategy, I calculate a propensity score of firearm accessibility for each observation in each of the imputed data sets. Then, I average the propensity scores for each respondent across the ten imputed data sets.

The second step is to match the “treatment” group comprising of individuals with in-home firearm access and the “control” group comprising of individuals without access based on their propensity scores. In order to ascertain the robustness of the results, I compare estimates from three different matching methods: (1) nearest-neighbor, (2) radius, and (3) kernel matching. Finally, I estimate the average treatment effect for the treated (ATT), which is the estimated effect of the treatment among treated individuals. The treatment and control groups are well matched, and in the matched sample, they are well-balanced. In the matched sample, standardized differences in each variable used for matching between the treatment and control groups were found to be small and statistically insignificant (results available upon request), which suggests that the two groups are remarkably similar based on observed characteristics.

4. Results

Table 1 presents summary statistics for selected variables while full summary statistics are presented in Table A2 in Supplementary Data. Summary statistics show that 22 and 16 percent of respondents reported easy access to guns at home in Wave 1 and Wave 2, respectively. Males were more likely to report in-home firearm access at both waves than female (by approximately 10 percentage point in both ways). In addition, female adolescents reported higher levels of depressive symptoms, and tended to feel slightly less safe in their neighborhoods and schools than male adolescents. About half of the respondents were female, and the average age was about 16 years old at Wave 1. About 54 percent of the

respondents were non-Hispanic white, while 22 percent were black, 16 percent were Hispanic, and 7 percent identified with other racial/ethnic groups.

Table 2 presents coefficients from fixed- and random-effects models that regressed changes in depressive symptoms on changes in in-home firearm access. Because of space constraints, only the coefficients of key explanatory variables are presented while full results are available in Table A3 in Supplementary Data. While I present both fixed- and random-effects estimates for comparison, a large test statistic ($p < 0.001$) in the Hausman specification test is evidence against the null hypothesis (and the random-effects assumptions) of independent individual effects. In short, based on this evidence, I conclude that the random-effects estimates are not consistent, and I reject them in favor of the fixed-effects estimates.

In Table 2, the first set of columns (Models 1–4) reports on fixed-effects models. Model 1 uses full sample, while Models 2 and 3 use female and male samples, separately. In Model 4, gender interaction term is added to Models 1, in order to assess whether the gender differences in the relationship between in-home firearm access and depression are statistically meaningful. Model 1, containing the full set of time-varying control variables, shows that the coefficient for in-home firearm access is positive and statistically significant, suggesting that firearm availability is associated with higher levels of depressive symptoms. To interpret, in-home firearm access increases depressive symptoms by 0.031, representing about 10 percent of a one-standard-deviation change in depressive symptoms.

Results in Models 2 and 3 indicate that easy access to guns at home is more strongly associated with depressive symptoms among females than males, and this association is statistically significant only among females. To assess these gender differences, the interaction term between in-home firearm access and the female dummy variable is added to Model 1. Results in Model 4 indicate that the interaction term is positive and statistically significant ($b = 0.034$), confirming the findings, shown in Models 2 and 3, that the association between in-home firearm access and depressive symptoms is largely driven by female adolescents. Although the fixed-effects models are preferred to the random-effects models for the analyses, it is interesting to note that the random-effects models yield considerably similar results (Models 5–8). In addition, these results were extremely robust to the inclusion of an extended set of time-varying covariates such as religious attendance, maternal emotional support, closeness to mother, maternal involvement, maternal employment, and friends' emotional support (Table A4, Supplementary Data).

Table 3 presents results for propensity score matching analyses, which intend to mimic an experimental design to compare depressive symptoms of the two groups matched on a wide range of observed characteristics with the exception of firearm accessibility. All three different matching estimates provide support for the earlier findings from fixed-effects models presented in Table 2. Results of Table 3 suggest that among female adolescents who had no access to household firearms at Wave 1, gaining in-home firearm access by Wave 2 increases depressive symptoms, while there is no such evidence for male adolescents.

In Table 4, I present fixed-effects estimates of the association between in-home firearm access and the perceptions of safety. Full results are presented in Table A5 in Supplementary Data. The first set of columns in Table 4 presents results for perceived neighborhood safety (Models 1–4), while the second set presents results for perceived school safety (Models 5–8). Models 1–4 show that firearm accessibility is not associated with perceived neighborhood safety for both females and males. Supplementary analyses, however, suggest that in-home firearm access decreases adolescents' perceptions of neighborhood connection, though there is no evidence of gender differences (Table A6, Supplementary Data). In contrast, as shown in Models 5–8, in-home firearm access reduces perceived school safety for females (Model 6), but not males (Model 7). Results in Model 8 show that the interaction term is statistically significant ($b = -0.102$), confirming the gender differences in the association between firearm accessibility and the perceptions of school safety.

First-difference models may not be entirely appropriate for estimating the models for the binary measure of perceived neighborhood safety. I thus ran sensitivity tests based on nonlinear, fixed-effects models of perceived neighborhood safety. Using only the respondents who change status in between waves, I modeled the conditional probability of perceived neighborhood safety using logistic regression (Allison, 2009). This means comparing respondents who perceived neighborhood safety (Wave 1 = 0 and Wave 2 = 1) with respondents who did not perceive neighborhood safety (Wave 1 = 1 and Wave 2 = 0). Results from this alternative specification were qualitatively similar to the ones presented in Table 4 (Table A7, Supplementary Data).

Finally, Table 5 provides propensity score matching estimates of the relationship between in-home firearm access and the perceptions of safety. Panel A presents results for perceived neighborhood safety, while Panel B presents results for perceived school safety. Results of Panel A suggest that both female and male adolescents who reported easy access to guns at home are similar to their controls in terms of depressive symptoms. In Panel B, however, both nearest-neighbor and kernel matching estimates consistently indicate that female adolescents who have gained access to household firearms between Waves 1 and 2 report lower levels of perceived school safety compared to their controls. In contrast, in-home firearm access does not increase males' perceived school safety. These results are consistent with the ones from the fixed-effects models, as shown in Table 4. In sum, the finding that in-home firearm access is related to depressive symptoms as well as perceived school safety only among females appears to support the major argument of this study that in-home firearm access undermines females' perceptions of safety, thereby leading to elevated depressive symptoms.

5. Discussion

With high prevalence of household firearms in the U.S., research has sought to understand its health-related consequences. While a number of studies have considered impact of firearm availability on physical health risks, primarily among gun owners in the household (Hemenway, 2011), relatively little is known about whether and how in-home firearm access shapes psychological outcomes for children of gun owners. Using a large, nationally representative longitudinal survey of U.S. adolescents, this study examines whether in-home

firearm access affects children's depressive symptoms and how these associations are potentially moderated by gender. Relying on fixed-effects regression as well as propensity score matching analyses, this study shows that firearm availability is significantly related to increased depressive symptoms of children of gun owners, supporting the first hypothesis of the study (H1). These results suggest that although the majority of gun owners decided to possess a gun to protect their homes and families, gun ownership can be harmful to their children's mental health.

Testing for moderating effects clearly reveals that the effect of in-home firearm access differs by gender, supporting the third hypothesis of this study (H3). The association between in-home firearm access and depressive symptoms is greater among females and statistically significant only for females, suggesting that the effects of firearm availability are driven largely by female adolescents. In addition, supplementary analyses provide some evidence on how in-home firearm access aggravates children's depressive symptoms and why female adolescents' depression is more affected. I argue that one of potential mechanisms that links firearm availability to depression for children of gun owners is through shifts in their perceptions of safety. Findings reveal that there is no statistically significant association between firearm availability and perceived neighborhood safety for both females and males. However, this study demonstrates that access to household firearms is negatively associated with perceived school safety only for females, offering support for the second and third hypotheses of the study (H2 and H3). These findings may be interpreted as evidence for the argument that female adolescents who gain access to guns at home may show higher levels of depressive symptoms because of their reduced perceptions of school safety. One explanation for the lack of evidence on perceived neighborhood safety could be that since most adolescents spend the majority of their time in school (Giordano, 2003), they may be more concerned about safety in school than in the neighborhood.

To place the magnitude of the results into perspective, the magnitude of effects found in this study (Cohen's $d \approx 0.08$ for full samples and 0.11 for female samples) is consistent with recent randomized controlled trials and meta-analyses of Cognitive Behavioral Therapy (CBT) for depression in youth, suggesting that the mean effect size for youth depression psychotherapy was approximately 0.08–0.30 (Clarke et al., 2016; Weersing and Brent, 2006; Weersing and Walker, 2008; Weisz et al., 2006). Using labor market consequences of adolescent depression as a benchmark, the observed effects found in this study (i.e., one-tenth of a standard deviation increase in depressive symptoms) is also associated with a nearly 2% earnings reduction (equivalent to about \$700 reduction in personal earnings before taxes for the samples in Add Health at Wave 4—i.e., adults aged about 29 years). To broaden the comparison, Currie and Hyson (1999) found that low birth weight status is associated with wage reductions of about 2–4%. Studies also show that one year of coursework (without completing a degree) at either a two- or a four-year school increases earnings by about 5–10% (Grubb, 2002; Kane and Rouse, 1995; Marcotte et al., 2005). These comparisons suggest that interventions that can reduce adolescent depressive symptoms (including prevention of in-home firearm access among adolescents) may have the potential to be cost effective.

This study contributes to existing literature on the health consequences of gun ownership in two major ways. First, previous work on the effects of gun availability have focused heavily on physical health risks of adult gun owners (e.g., the risk of homicide and suicide) and their children (e.g., firearm-related accidents), while its psychological effects, particularly on their children, are largely ignored. This study is the first to establish whether and how in-home firearm access shapes mental health for children of gun owners. Findings clearly suggest that access to household firearms is related to an increase in depressive symptoms, particularly for female adolescents, and these effects may occur through shifts in their safety perceptions about school. Second, this study provides rigorous evidence of the association by using longitudinal models to reduce bias arising from both observed and unobserved heterogeneity, known as substantial threats to causal inference. More specifically, this study relies on both fixed-effects models and propensity score models to triangulate the association between firearm availability and depression since each method provides useful and distinct information.

5.1. Limitations

This study has several limitations. First, although this study provides suggestive evidence that the perceptions of safety may be one of the potential mechanisms linking firearms accessibility and depression, it was unable to more directly test this argument due mainly to data limitations (i.e., lack of longer panels). In addition, this study was unable to determine whether the feelings of insecurity among children of gun owners are attributable to the presence of household firearms per se or their access to them. Similarly, this study could not test plausibly one of the most important mechanisms linking in-home gun access to psychological well-being among children of gun owners—i.e., anxiety or concerns about firearm-related accidents. While my auxiliary analyses suggest that in-home firearm access is associated with heightened levels of fearfulness that often coincides with anxiety (Table A8 in Supplementary Data), these results are far from conclusive because the reasons for fearfulness are not specified. Thus, future research is required to further investigate how household gun ownership shapes adolescents' perceptions of safety and psychological well-being.

Second, even with detailed, prospectively collected data and rigorous methods, the estimated associations may still suffer from bias. Although the fixed-effects models eliminate bias due to time-invariant (observed and unobserved) heterogeneity, time-varying unobservables remain a potential source of bias. The inclusion of a set of observed time-varying controls can only reduce but not eliminate bias. In addition, the fixed-effects model cannot rule out the possibility of reverse causation. In particular, reverse causation may be a potential concern with the outcome of perceived safety because a child's perceptions of safety may influence firearm acquisition by parents, which in turn increases the likelihood that a child gains access to guns at home. Therefore, the estimated effects of firearm accessibility on perceived safety may be downwardly biased by reverse causation. While propensity score matching analysis, where the temporal ordering of the variables is relatively better established, yields similar estimates as in fixed-effects models, it does not resolve the issue of reverse causation, and therefore, further evidence on the causal effects of in-home firearm access is required.

Third, readers should consider that the Add Health Wave 1 and Wave 2 surveys were conducted in 1995 and 1996, respectively. Despite the limitation that Add Health is somewhat outdated, however, I confirm that Add Health is the only dataset with adolescent samples that contains both measures of in-home firearm access and depressive symptoms. Although the trends in household gun ownership have remained relatively stable over the last 20 years (Pew Research Center, 2013; Smith and Son, 2015), attitudes toward household firearms may or may not be different today than they were when the data were collected, and future research should use more recent data. Yet, since gun ownership is still contentious and highly relevant social issues today, the findings of this study may provide meaningful and relevant implications even for today's society.

5.2. Policy recommendations

The findings of this study have important policy implications. First, this study reaffirms the need to restrict adolescents' access to firearms at home (Barber and Miller, 2014). In addition to reducing a risk for suicide and firearm-related accidents (Grossman et al., 2005; Simonetti et al., 2015), my findings suggest that safe storage practices may help protect children from anxiety and depression. Legislation may be one way to promote safe gun storage. For instance, child access prevention (CAP) laws impose criminal liability on adults who negligently leave firearms accessible to children. In fact, research suggests that CAP laws are associated with a moderate reduction in firearm suicides and unintentional firearm injuries among children and adolescents (Rivara, 2015; Webster et al., 2004), though further evidence for the causal effects of the laws is required. In addition, another approach to encouraging safe practices related to firearm storage and use may be through clinic- or community-based interventions. Reviewing randomized and quasi-experimental controlled studies of the effectiveness of clinic- and community-based firearm storage interventions, Rowhani-Rahbar et al. (2016) found that counseling interventions showed improvement in safe storage practices only when a free storage device is provided.

Second, this study suggests that preventive interventions on adolescent depression may benefit from targeting those who are exposed to household firearms. While prevention efforts are strongly encouraged to specifically target adolescents with potential risk factors for depression, such as exposure to violence, social isolation, child maltreatment, and family breakup (Das et al., 2016; Gladstone et al., 2011), in-home firearm access is a novel risk factor for adolescent depression. Thus, individual-/family-based interventions for gun-owning families should be considered. Furthermore, my findings provide some insights into school-based prevention programs. My suggestive finding that in-home firearm access may increase depressive symptoms through a decrease in the perception of school safety indicates that school-based mental health programs designed to help reduce students' safety concerns specifically associated with gun violence and school shooting may be effective.

Finally, the findings of this study add new evidence to previous work that argues that the social cost of household firearms will outweigh the benefits. Scholars have suggested that there is no evidence to show that gun ownership and availability actually deter crime or reduce the likelihood or severity of injury during the commission of a crime (Hemenway, 2011; McDowall et al., 1991). In contrast, there is a relatively vast literature on the physical

health risks of having a gun at home: homicide (Hepburn and Hemenway, 2004), suicide (Florentine and Crane, 2010; Miller and Hemenway, 1999), gun violence (school shooting), and gun-related accidents (Johnson et al., 2004). As shown in the current study, firearm ownership does have psychological effects on individuals in gun-owning households who do not personally own guns (children in this study), as well as those in households without guns. This is also consistent with the argument in extant literature that while the decision to acquire a firearm is personal, it has public ramifications, which create negative externalities to gun ownership (Hemenway et al., 1995; Miller et al., 2000). In the wake of nationally reported school shooting incidents and increasing rates of gun crime and violence, adolescents' perceptions of safety, especially about school, will be shaped more strongly by gun ownership and availability by others, as this study argues, including their family members.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.socscimed.2017.11.044>.

References

- Allison, P. Fixed Effects Regression Models. SAGE Publications, Inc; Thousand Oaks, CA: 2009.
- Allison, PD. Missing Data. Sage Publications; Thousand Oaks, CA: 2002.
- Anglemyer A, Horvath T, Rutherford G. The accessibility of firearms and risk for suicide and homicide victimization among household members: a systematic review and meta-analysis. *Ann Intern Med*. 2014; 160:101–110. [PubMed: 24592495]
- Azrael D, Hemenway D. "In the safety of your own home": results from a national survey on gun use at home. *Soc Sci Med*. 2000; 50:285–291. [PubMed: 10619696]
- Azrael D, Hepburn L, Hemenway D, Miller M. The stock and flow of US firearms: results from the 2015 national firearms survey. *RSF russell sage found. J Soc Sci*. 2017; 3:38–57.
- Barber CW, Miller MJ. Reducing a suicidal person's access to lethal means of suicide: a research agenda. *Am J Prev Med*. 2014; 47:264–272.
- Blair E, Hyatt EM. The marketing of guns to women: factors influencing gun-related attitudes and gun ownership by women. *J Public Policy Mark*. 1995; 14:117–127.
- Borowsky IW, Taliaferro LA, McMorris BJ. Suicidal thinking and behavior among youth involved in verbal and social bullying: risk and protective factors. *J Adolesc Heal*. 2013; 53:S4–S12.

- Cavanaugh MR, Bouffard JA, Wells W, Nobles MR. Student attitudes toward concealed handguns on campus at 2 universities. *Am J Public Health*. 2012; 102:2245–2247. [PubMed: 22720763]
- Clarke G, et al. Cognitive behavioral therapy in primary care for youth declining antidepressants: a randomized trial. *Pediatrics*. 2016; 137:e20151851–e20151851. [PubMed: 27244782]
- Cook PJ, Ludwig J. The social costs of gun ownership. *J Public Econ*. 2006; 90:379–391.
- Currie J, Hyson R. Is the impact of health shocks cushioned by socioeconomic status? The Case of Low Birthweight. *Am Econ Rev*. 1999; 89:245–250.
- Das JK, et al. Interventions for adolescent mental health: an overview of systematic reviews. *J Adolesc Heal*. 2016; 59:S49–S60.
- Firebaugh, G., Warner, C., Massoglia, M. Fixed effects, random effects, and hybrid models for causal analysis. In: Morgan, SL., editor. *Handbook of Causal Analysis for Social Research*. Springer; Netherlands, Dordrecht: 2013. p. 113-132.
- Florentine JB, Crane C. Suicide prevention by limiting access to methods: a review of theory and practice. *Soc Sci Med*. 2010; 70:1626–1632. [PubMed: 20207465]
- Garrido MM, et al. Methods for constructing and assessing propensity scores. *Health Serv Res*. 2014; 49:1701–1720. [PubMed: 24779867]
- Giordano PC. Relationships in adolescence. *Annu Rev Sociol*. 2003; 29:257–281.
- Gladstone TRG, Beardslee WR, O'Connor EE. The prevention of adolescent depression. *Psychiatr Clin North Am*. 2011; 34:35–52. [PubMed: 21333838]
- Grossman DC, et al. Gun storage practices and risk of youth suicide and unintentional firearm injuries. *JAMA*. 2005; 293:707–714. [PubMed: 15701912]
- Grubb WN. Learning and earning in the middle, part II: state and local studies of pre-baccalaureate education. *Econ Educ Rev*. 2002; 21:401–414.
- Halaby CN. Panel models in sociological research: theory into practice. *Annu Rev Sociol*. 2004; 30:507–544.
- Hamada S, et al. Association between bullying behavior, perceived school safety, and self-cutting: a Japanese population-based school survey. *Child Adolesc Ment Health*. 2016
- Harris MB, Miller KC. Gender and perceptions of danger. *Sex Roles*. 2000; 43:843–863.
- Hauser W, Kleck G. Guns and fear: a one-way street? *Crime Delinq*. 2013; 59:271–291.
- Hausman JA. Specification tests in econometrics. *Econometrica*. 1978; 46:1251.
- Heckman J, Ichimura H, Smith J, Todd P. Characterizing selection bias using experimental data. *Econometrica*. 1998; 66:1017.
- Hemenway D. Risks and benefits of a gun in the home. *Am J Lifestyle Med*. 2011; 5:502–511.
- Hemenway D. National attitudes concerning gun carrying in the United States. *Inj Prev*. 2001; 7:282–285. [PubMed: 11770652]
- Hemenway D, Barber C, Miller M. Unintentional firearm deaths: a comparison of other-inflicted and self-inflicted shootings. *Accid Anal Prev*. 2010; 42:1184–1188. [PubMed: 20441829]
- Hemenway D, Solnick SJ, Azrael DR. Firearms and community feelings of safety. *J Crim Law Criminol*. 1995; 86:121.
- Hepburn LM, Hemenway D. Firearm availability and homicide: a review of the literature. *Aggress Violent Behav*. 2004; 9:417–440.
- Hill GD, Howell FM, Driver ET. Gender, fear, and protective handgun ownership. *Criminology*. 1985; 23:541–552.
- Hill, J. Reducing Bias in Treatment Effect Estimation in Observational Studies Suffering from Missing Data. Columbia University Institute for Social Social and Economic Research and Policy (ISERP); 2004. Working Paper 04–01
- Johnson RM, et al. Are household firearms stored less safely in homes with adolescents?: Analysis of a national random sample of parents. *Arch Pediatr Adolesc Med*. 2006; 160:788–792. [PubMed: 16894076]
- Johnson RM, Coyne-Beasley T, Runyan CW. Firearm ownership and storage practices, U.S. households, 1992–2002: a systematic review. *Am J Prev Med*. 2004; 27:173–182. [PubMed: 15261906]

- Kane TJ, Rouse CE. Labor market returns to two- and four-year colleges: is a credit a credit and do degrees matter? *Am Econ Rev*. 1995; 85:600–614.
- Karp, A. Small Arms Survey. Geneva, Switzerland: 2011. Estimating Civilian Owned Firearms.
- Kohoulat N, Dehghani MR, Kohoulat N. Perceived school climate and students' mental health. *Int J Sch Heal*. 2015; 2:0–5.
- Marcotte DE, Bailey T, Borkoski C, Kienzl GS. The returns of a community college education: evidence from the national education longitudinal survey. *Educ Eval Policy Anal*. 2005; 27:157–175.
- McDowall D, Lizotte AJ, Wiersema B. General deterrence through civilian gun ownership: an evaluation of the quasi-experimental evidence. *Criminology*. 1991; 29:541–560.
- Meier AM. Adolescent first sex and subsequent mental health. *Am J Sociol*. 2007; 112:1811–1847.
- Miller M, Azrael D, Hemenway D. Community firearms, community fear. *Epidemiology*. 2000; 11:709–714. [PubMed: 11055635]
- Miller M, Azrael D, Hemenway D, Vriniotis M. Firearm storage practices and rates of unintentional firearm deaths in the United States. *Accid Anal Prev*. 2005; 37:661–667. [PubMed: 15949457]
- Miller M, Barber C, White RA, Azrael D. Firearms and suicide in the United States: is risk independent of underlying suicidal behavior? *Am J Epidemiol*. 2013; 178:946–955. [PubMed: 23975641]
- Miller M, Hemenway D. The relationship between firearms and suicide: a review of the literature. *Aggress Violent Behav*. 1999; 4:59–75.
- Miller M, Hemenway D, Azrael D. State-level homicide victimization rates in the US in relation to survey measures of household firearm ownership, 2001–2003. *Soc Sci Med*. 2007; 64:656–664. [PubMed: 17070975]
- New Yorkers Against Gun Violence. Fact Sheet: Accidental Shootings. NYAGV; New York, NY: 2013.
- Papachristos AV, Wildeman C, Roberto E. Tragic, but not random: the social contagion of nonfatal gunshot injuries. *Soc Sci Med*. 2015; 125:139–150. [PubMed: 24560101]
- Patten R, Thomas MO, Viotti P. Sweating bullets: female attitudes regarding concealed weapons and the perceptions of safety on college campuses. *Race, Gend Cl*. 2013; 20:269–290.
- Pew Research Center. Protection Is Now Top Reason. Pew Research Center; Washington, D.C.: 2013. Why Own a Gun?.
- Rivara FP. Youth suicide and access to guns. *JAMA Pediatr*. 2015; 169:429–430. [PubMed: 25751519]
- Rowhani-Rahbar A, Simonetti JA, Rivara FP. Effectiveness of interventions to promote safe firearm storage. *Epidemiol Rev*. 2016; 38:111–124. [PubMed: 26769724]
- Royston P. Multiple imputation of missing values. *Stata J*. 2004; 4:227–241.
- Shapiro JP, Dorman RL, Welker CJ, Clough JB. Youth attitudes toward guns and violence: relations with sex, age, ethnic group, and firearm exposure. *J Clin Child Psychol*. 1998; 27:98–108. [PubMed: 9561942]
- Simonetti JA, et al. Psychiatric comorbidity, suicidality, and in-home firearm access among a nationally representative sample of adolescents. *JAMA Psychiatry*. 2015; 72:152. [PubMed: 25548879]
- Small Arms Survey. Small Arms Survey 2007: Guns and the City. Graduate Institute of International Studies; Geneva, Switzerland: 2007.
- Smith, TW., Son, J. Trends in Gun Ownership in the United States, 1972–2014. National Opinion Research Center at the University of Chicago; Chicago, IL: 2015.
- Stroud A. Good Guys with guns. *Gend Soc*. 2012; 26:216–238.
- Thompson A, et al. Student perceptions and practices regarding carrying concealed handguns on university campuses. *J Am Coll Heal*. 2013; 61:243–253.
- Vaisey S, Miles A. What you can—and can't—do with three-wave panel data. *Sociol Methods Res*. 2017; 46:44–67.
- von Hippel PT. Regression with missing Ys: an improved strategy for analyzing multiply imputed data. *Sociol Methodol*. 2007; 37:83–117.
- Webster DW, Vernick JS, Zeoli AM, Manganello JA. Association between youth-focused firearm laws and youth suicides. *JAMA*. 2004; 292:594–601. [PubMed: 15292085]

- Weersing VR, Brent DA. Cognitive behavioral therapy for depression in youth. *Child Adolesc Psychiatr Clin N Am*. 2006; 15:939–957. [PubMed: 16952769]
- Weersing VR, Walker PN. Review: Cognitive behavioural therapy for adolescents with depression. *Evid Based Ment Health*. 2008; 11:76–76. [PubMed: 18669678]
- Weisz JR, McCarty CA, Valeri SM. Effects of psychotherapy for depression in children and adolescents: a meta-analysis. *Psychol Bull*. 2006; 132:132–149. [PubMed: 16435960]
- Winship C, Morgan SL. The estimation of causal effects from observational data. *Annu Rev Sociol*. 1999; 25:659–706.
- Wolfson JA, Teret SP, Azrael D, Miller M. US public opinion on carrying firearms in public places. *Am J Public Health*. 2017; 107:929–937. [PubMed: 28426305]
- Wright DR, Fitzpatrick KM. Social capital and adolescent violent behavior: correlates of fighting and weapon use among secondary school students. *Soc Forces*. 2006; 84:1435–1453.
- Zimmerman GM, Rees C, Farrell C. Contextual determinants of adolescent perceived early fatality. *J Youth Adolesc*. 2016; 45:1546–1559. [PubMed: 27325518]

Table 1

Descriptive statistics for selected variables, National Longitudinal Study of Adolescent to Adult Health (Add Health).

	Full				Female		Male	
	Mean	SD	Min	Max	Mean	SD	Mean	SD
<i>In-home firearm access</i>								
Easy access to gun at home (W1)	0.216	0.411	0.0	1.0	0.164	0.371	0.269	0.444
Easy access to gun at home (W2)	0.162	0.368	0.0	1.0	0.120	0.325	0.205	0.404
<i>Dependent variables</i>								
Depressive symptoms	0.593	0.397	0.0	2.8	0.643	0.430	0.541	0.353
Feel safe in neighborhood	0.887	0.317	0.0	1.0	0.877	0.328	0.896	0.305
Feel safe in school	3.746	1.040	1.0	5.0	3.741	1.027	3.750	1.054
Perceived neighborhood connection	0.765	0.958	0.0	3.0	0.817	0.988	0.710	0.921
Happy to be living in neighborhood	3.922	1.023	1.0	5.0	3.894	1.041	3.950	1.003
<i>Demographic characteristics</i>								
Female	0.513	0.500	0.0	1.0	1.000	0.000	0.000	0.000
Age	15.798	1.614	12.0	21.0	15.720	1.604	15.880	1.620
Race/ethnicity								
White	0.544	0.498	0.0	1.0	0.542	0.498	0.546	0.498
Black	0.224	0.417	0.0	1.0	0.236	0.425	0.211	0.408
Hispanic	0.158	0.364	0.0	1.0	0.153	0.360	0.162	0.369
Other race/ethnicity	0.074	0.262	0.0	1.0	0.069	0.253	0.080	0.271
Observations	14013				7183		6830	

Note. Summary statistics are based on Wave 1 data unless otherwise indicated.

Table 2

Fixed-effects and random-effects estimates of the association between in-home firearm access and depressive symptoms.

Sample	Fixed-effects model				Random-effects model			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full	Female	Male	Full	Full	Female	Male	Full
<i>In-home firearm access</i>								
Easy access to guns at home (A)	0.031 *** (0.008)	0.051 *** (0.013)	0.017 (0.009)	0.017 (0.010)	0.029 *** (0.005)	0.052 *** (0.009)	0.012 * (0.006)	0.013 (0.007)
(A) × Female				0.034 * (0.016)				0.039 *** (0.010)
Observations	14013	7183	6830	14013	14013	7183	6830	14013

Note. Robust standard errors are presented in parentheses. Fixed-effects models include the following time-varying control variables: self-reported health status, self-reported GPA, rural status, family suicide attempts, and friend suicide attempts. In addition to control variables used in fixed-effects models, random-effects models include the following time-constant control variables: gender, age, race/ethnicity (non-Hispanic White, Black, Hispanic ethnicity, and others), grade level, ability test scores (measured by the standardized Peabody Picture Vocabulary Test [PVT]), mother's education, and family income.

* $p < 0.05$;

** $p < 0.01$;

*** $p < 0.001$.

Table 3

Propensity score matching estimates of the association between in-home firearm access and Wave 2 depressive symptom.

	Nearest-neighbor		Radius (0.02)		Kernel	
	Female	Male	Female	Male	Female	Male
Average outcome for matched treated	0.687	0.582	0.688	0.582	0.687	0.582
Average outcome for matched controls	0.610	0.555	0.616	0.548	0.618	0.545
Difference between the treated and controls						
ATT	0.077 *	0.027	0.072 **	0.034	0.069 *	0.037
Standard errors	0.036	0.029	0.027	0.022	0.027	0.022
Number of treated observations	273	353	273	353	273	353
Number of control observations	273	353	5644	4448	5646	4459

Note. ATT = Average treatment effect for the treated. A caliper of 0.02 for radius matching was determined by calculating 0.2 of the standard deviation of the logit of the propensity score.

* $p < 0.05$;

** $p < 0.01$;

*** $p < 0.001$.

Table 4
Fixed-effects estimates of the association between in-home firearm access and perceived safety.

Sample	Feel safe in neighborhood				Feel safe in school			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full	Female	Male	Full	Full	Female	Male	Full
<i>In-home firearm access</i>								
Easy access to guns at home (A)	0.008 (0.008)	-0.006 (0.012)	0.019 (0.010)	0.019 (0.011)	-0.030 (0.025)	-0.088* (0.039)	0.013 (0.034)	0.014 (0.034)
(A) × Female				-0.026 (0.016)				-0.102* (0.051)
Observations	13965	7160	6805	13965	12638	6518	6120	12638

Note. See Note for Table 2.

* $p < 0.05$;

** $p < 0.01$;

*** $p < 0.001$.

Propensity score matching estimates of the association between in-home firearm access and Wave 2 perceived safety.

Table 5

Panel A. Feel safe in neighborhood	Nearest-neighbor		Radius (0.02)		Kernel	
	Female	Male	Female	Male	Female	Male
Average outcome for matched treated	0.865	0.884	0.864	0.884	0.864	0.884
Average outcome for matched controls	0.868	0.890	0.880	0.887	0.879	0.887
Difference between the treated and controls						
ATT	-0.004	-0.006	-0.016	-0.003	-0.015	-0.003
Standard errors	0.031	0.025	0.022	0.018	0.022	0.018
Number of treated observations	266	353	266	353	266	353
Number of control observations	266	353	5510	4429	5512	4440
Panel B. Feel safe in school	Nearest-neighbor		Radius (0.02)		Kernel	
	Female	Male	Female	Male	Female	Male
Average outcome for matched treated	3.598	3.799	3.597	3.808	3.597	3.799
Average outcome for matched controls	3.815	3.744	3.717	3.785	3.734	3.786
Difference between the treated and controls						
ATT	-0.217*	0.056	-0.120	0.023	-0.138*	0.013
Standard errors	0.089	0.080	0.068	0.059	0.067	0.060
Number of treated observations	254	324	254	324	254	324
Number of control observations	254	324	5235	4141	5239	4152

Note. See Note for Table 3.

* $p < 0.05$;

** $p < 0.01$;

*** $p < 0.001$.