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Firearm Ownership and Acquisition Among Parents with Risk Factors for Self-harm or Other Violence

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Abstract

Objective—Recent policy initiatives aiming to reduce firearm morbidity focus on mental health and illness. However, few studies have simultaneously examined mental health and behavioral predictors within families, or their longitudinal association with newly acquiring a firearm.

Methods—Population-based, longitudinal survey of 4,251 parents of fifth-grade students in three US metropolitan areas; 2004–2011. Multivariate logistic models assessed associations between owning or acquiring a firearm and parent mental illness and substance use.

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Contributors' Statement
Joseph A. Ladapo conceptualized and designed the study, carried out the initial analyses, drafted the initial manuscript, and approved the final manuscript as submitted.
Marc N. Elliott designed the data collection instruments, supervised the initial analyses, critically reviewed the manuscript, and approved the final manuscript as submitted.
David E. Kanouse, David C. Schwebel, Sara L. Toomey, Sylvie Mrug, Paula M. Cuccaro, and Susan R. Tortolero designed the data collection instruments, critically reviewed the manuscript, and approved the final manuscript as submitted.
Mark A. Schuster conceptualized and designed the study, designed the data collection instruments, critically reviewed the manuscript, approved the final manuscript as submitted, and provided overall supervision of the study.

Results—Ninety-three percent of parents interviewed were women. Overall, 19.6% of families reported keeping a firearm in the home. After adjustment for confounders, history of depression (aOR 1.36, 95% CI 1.04–1.77), binge drinking (aOR 1.75, 95% CI 1.14–2.68), and illicit drug use (aOR 1.75, 95% CI 1.12–2.76) were associated with a higher likelihood of keeping a firearm in the home. After a mean of 3.1 years, 6.1% of parents who did not keep a firearm in the home at baseline acquired one by follow-up and kept it in the home (average annual likelihood=2.1%). No risk factors for self-harm or other violence were associated with newly acquiring a gun in the home.

Conclusions—Families with risk factors for self-harm or other violence have a modestly greater probability of having a firearm in the home compared with families without risk factors, and similar probability of newly acquiring a firearm. Treatment interventions for many of these risk factors may reduce firearm-related morbidity.

Keywords

firearm ownership; firearm acquisition; self-harm; violence

Introduction

Risk factors for self-harm and other violence, particularly those related to mental health and mental illness, are the focus of recent policy initiatives aimed at reducing firearm-related morbidity and mortality.[1] Catalyzed by the recent killings in Newtown, Connecticut; Oak Creek, Wisconsin; Aurora, Colorado; and Santa Barbara, California, among other tragedies, these initiatives have largely involved: laws that require mental health providers to notify authorities about patients who are a potential danger to themselves or others,[2] efforts to strengthen background check databases for individuals purchasing firearms,[3] and proposals to expand access to mental health treatment services.[4] In addition, professional societies have reaffirmed or expanded recommendations that clinicians perform preventive screening by asking patients about firearms and storage patterns in the home,[5–9] partly because of the significant association between firearm ownership and self-injury.[10–13] For example, a recent policy statement issued by the American College of Physicians (ACP) recommends extending firearm restrictions to persons with dementia, in addition to children and adults with mental illness or substance use disorders.[5]

However, critics of these initiatives have raised several concerns, including their potentially deleterious impact on patients' willingness to seek mental health care and disclose sensitive information[2]; limited scientific evidence supporting their effectiveness at reducing firearm injury[3,14]; uncertainty about clinicians' ability to identify violent persons[2]; and infringement on privacy rights of persons with mental illness or other risk factors. To help provide context for these debates, we aimed to (1) assess the prevalence of keeping a firearm in the home among families with parents who have risk factors for self-harm or other violence such as mental illness or substance use, and (2) determine whether these risk factors are associated with a higher probability of newly acquiring a gun, compared to parents without risk factors.

Although prior studies have evaluated the relationship between psychosocial factors and gun ownership,[15–17] few studies have simultaneously examined several mental health and

behavioral predictors within families. These studies, primarily cross-sectional in design, have generally found that patients with mental illness are no more or less likely to own a firearm, but longitudinal datasets—uncommon in firearms research—could better inform screening recommendations about firearms acquisition and identify individuals at risk for self-harm or other violence. Our work aims to address these gaps, while also directly addressing the Institute of Medicine's recent call for research on the scope of gun ownership and acquisition in populations with risk factors for self-harm or other violence.[1]

Methods

We analyzed data from Healthy Passages, a longitudinal study of fifth-grade children and their parents interviewed between August 2004 and September 2006 (T1) and followed up in seventh grade (T2; August 2006 to September 2008) and tenth grade (T3; January 2010 to June 2011). Healthy Passages was designed to collect data on health risk behaviors, health outcomes, and disparities, and detailed methods have been previously described.[18,19] Using study site computers, each parent–child dyad completed computer-assisted personal interviews in English or Spanish and audio-computer-assisted self-interviews for sensitive questions. Interviews were completed at parents' homes, study centers, or other preferred locations. Parents provided informed consent for themselves and their children; children also gave assent. Institutional review boards at each study site and the Centers for Disease Control and Prevention approved the study. All analyses in this study are based on data from T2 and T3, when risk factors of interest were measured.

Study population

Study participants were recruited from 10 contiguous public school districts in and around Birmingham, Alabama; the largest public school district in Houston, Texas; and 25 contiguous public school districts in Los Angeles County, California. Schools that enrolled at least 25 fifth-grade students were eligible for inclusion (this threshold represents over 99% of all students enrolled in public schools at each of the three sites). To achieve a balanced sample of children who were non-Hispanic black, Hispanic, and non-Hispanic white, Healthy Passages sampled schools with probabilities that accounted for a school's racial/ethnic mix. Parents of each fifth-grade student at each school received a letter requesting permission for study personnel to contact them.

Among 11,532 fifth-grade students enrolled in 118 sampled schools, the parents of 6,663 students agreed to be contacted, and 5,147 parent–child dyads participated in the study. Of these dyads, 4,297 also participated at T2 and T3.

Primary Outcome: Firearm Ownership and Acquisition

The primary outcome measure was the presence of a firearm in the home at T3. After instructing parents to exclude "BB guns, starter pistols, paintball guns, or guns that cannot fire," we asked, "Are any firearms now kept in or around your home? Include those kept in a garage, outdoor storage area, truck, or car" (*yes* or *no*). There were 1.3% of parents who declined to answer the question at T3 or said that they did not know; these respondents were excluded from our analyses. Parents were asked the same question at T2, and only families

who did not keep a firearm in the home at this time point were included in our longitudinal analysis of firearm acquisition. No parents at T2 declined to answer or said they did not know.

Mental Health Measures in Parents

At T2 and T3, parents completed the Brief Symptom Inventory (BSI-18), a validated instrument for assessing an individual's level of psychological distress across three dimensions: somatization, depression, and anxiety.[20] These three dimensions were combined into a summary measure, the global distress score, and we used a previously validated threshold (global symptom score above the 90th percentile, T-score ≥ 63, in a community sample) to identify parents with significant psychological distress. The BSI-18 is designed to be a screening tool for psychiatric and psychological disorders and has been validated in several patient populations.[20] At T3 only, parents were also asked whether they were ever diagnosed with depression, anxiety, or bipolar disorder: "Has a doctor or health professional ever told you that you had any of the following health conditions?" (*yes* or *no*). Parents who responded "yes" for any of these conditions were subsequently asked, "Have you been treated or provided counseling by a health care professional for [condition] during the past 12 months?" (*yes* or *no*).

Other Parental Risk Factors for Self-harm or Violence

At T2 and T3, we assessed two parental behavioral and psychosocial factors previously shown to be associated with adult self-harm or other violence: binge drinking[21] and illicit drug use.[13,22] To assess alcohol use, we asked parents, "During the past 12 months how often did you have 5 or more drinks of alcohol in a row, that is, within a couple of hours?" Those who reported having 5 or more successive drinks monthly or more frequently were classified as binge drinkers.[23] To assess illicit drug use, we asked parents whether they had used "illegal drugs for non-medical use" during the past 12 months, not including marijuana (*yes* or *no*). These items were adapted from questions developed by the National Institute on Alcohol Abuse and Alcoholism's Task Force on Recommended Alcohol Questions.

Other Variables

Socioeconomic and demographic measures included study site, parent age, race/ethnicity (non-Hispanic black, Hispanic, non-Hispanic white, and other), highest household education (no high school degree, high school degree, some college, and college degree or greater), and annual household income (<$25,000; $25,000–$49,999; $50,000–$99,999; ≥$100,000), all of which were available at T2 and T3, with the exception of study site and highest household education, which were based on reporting at T1. Because respondents were primarily women and gun owners are more often men,[24] we created three categories to represent these factors (female respondent, adult male in home; female respondent, no adult male in home; male respondent). These three categories were incorporated in regression models, with "female respondent, adult male in home" as the reference group, to ameliorate potential confounding attributable to the association between a keeping a firearm in the home, the respondent's sex and household composition, and risk factors for self-harm or other violence. To account for neighborhood safety, which we hypothesized could affect gun

ownership, we asked parents, “How safe is it to walk around alone in your neighborhood after dark?” (*completely safe*, *fairly safe*, *somewhat dangerous*, or *extremely dangerous*).

Statistical Analysis

Descriptive analyses of characteristics of families in our cohort used measures from T3. We estimated multivariate logistic regression models to examine differences in the odds of (a) keeping a firearm in the home at T3 based on characteristics at T3, and (b) acquiring a firearm by T3 based on characteristics at T2, while controlling for the sociodemographic variables previously described (see Table 1a). In our analysis of firearm acquisition, we assumed that the acquisition rate was constant and excluded families that already kept a gun in the home at T2 (N=815). Multivariate regression models were used to estimate covariate-adjusted probabilities of keeping a firearm in the home (also known as “recycled predictions”).[25] For each of these analyses, the independent variables were sociodemographic characteristics and potential risk factors for self-harm and other violence. Depression, anxiety, and bipolar disorder diagnoses were not included in the firearm acquisition model because they were only available at T3. We also constructed simple logistic regressions to assess whether treatment rates for mental illness were associated with firearm ownership in the home, using models that only included patients with a history of mental illness. These models were developed because we hypothesized that higher rates of untreated mental illness may be associated with different rates of firearm ownership among patients with a history of mental illness. We performed mean imputation from the overall sample for parent age (missing <1%), neighborhood safety (missing <2%), and highest household education (missing <2%) and added a “missing” category for income (3% missing). Because a very small proportion of our data was missing, we anticipated our results would be largely insensitive to these missing data and therefore chose to use mean imputation rather than a complex multiple imputation model.[26] The study population was limited to parents who completed surveys at all three time-points. All analyses used longitudinal weights that accounted for the effects of design, nonresponse, clustering of parents’ children within schools, and retention at all three time-points. Analyses and stratification by site were performed using the svy suite of commands in Stata (version 12, College Station, Texas).[18]

Results

Sample Characteristics

At T3, 93% of the 4,251 parents interviewed were women (Table 1b). Twenty-nine percent were black, 42% were Hispanic, 24% were white, and 5% were another race/ethnicity. The mean age was 44.2 years (SE=1.2), median family income was $25,000 to $49,999, and 23% of parents did not complete high school. Twenty-one percent and 3% of parents reported living in a neighborhood that was somewhat dangerous or extremely dangerous, respectively.

Prevalence of Firearms in Homes

Overall, 19.6% of families (35.9% in Birmingham, 18.5% in Houston, and 5.9% in Los Angeles) reported keeping a gun in the home at T3. In unadjusted analyses, parents with significant psychological distress were less likely to keep a firearm in the home, while

parents with a history of depression were more likely to have a firearm (Table 2). Among parents who kept a gun in the home and had a history of depression, anxiety, or bipolar disorder, rates of pharmacological or non-pharmacological treatment were 58%, 70%, and 80%, respectively. Keeping a firearm in the home was not significantly associated with receiving treatment for any of these risk factors.

After adjustment for potential confounders, only a history of depression (aOR 1.36, 95% CI 1.04–1.77), binge drinking (aOR 1.75, 95% CI 1.14–2.68), and illicit drug use (aOR 1.75, 95% CI 1.12–2.76) were associated with a higher likelihood of keeping a firearm in the home. The adjusted marginal probabilities of keeping a firearm in the home, which differed modestly from the unadjusted probabilities reported in Table 2, appear in Figure 1.

Incidence of Firearm Acquisition

After a mean interval of 3.1 years, 6.1% of parents who did not keep a firearm in the home at T2 acquired a firearm by T3 and kept it in the home, equivalent to an average annual likelihood of acquisition of 2.1% (Table 3). In unadjusted and adjusted analyses, no risk factors for self-harm or other violence were associated with acquiring a gun in the home. Adjusted marginal probabilities are shown in Figure 2.

Sensitivity Analyses

We performed a sensitivity analysis in which we separately assessed marijuana use and other illicit drug use in our primary regression model, based on a question about whether a respondent had “used marijuana, pot, or hashish for non-medical use” during the past 12 months. This analysis demonstrated that marijuana use was independently associated with keeping a firearm in the home (aOR 2.23, 95% CI 1.41–3.53), but there were no meaningful changes in the adjusted odds ratios for other illicit drug use (aOR 1.71, 95% CI 1.07–2.73), depression (aOR 1.36, 95% CI 1.04–1.79), and binge drinking (aOR 1.62, 95% CI 1.06–2.46). We performed an additional sensitivity analysis in which we excluded neighborhood safety from our primary regression model; our findings were robust to this change (depression aOR 1.37, 95% CI 1.05–1.79; binge drinking aOR 1.75, 95% CI 1.13–2.70; illicit drug use aOR 1.75, 95% CI 1.11–2.75).

Discussion

We found that the prevalence of firearms in homes of families with risk factors for self-harm or other violence—as reported primarily by mothers—was high, and that some risk factors for violence, including history of depression, binge drinking, and illicit drug use, were associated with an incrementally higher probability of keeping a gun in the home. Though most risk factors were unrelated to the likelihood of acquiring a firearm in the future, the average annual incidence of firearm acquisition was appreciable, affecting 1 in 50 families over a 3.1 year period. To the best of our knowledge, this study examines the broadest range to date of risk factors for violence among families who keep a firearm in the home, and is the first to examine longitudinal associations between these risk factors and firearm acquisition.

As previous studies have shown,[15–17] we find that the prevalence of firearm ownership is high both among persons with and without mental illness, though rates of ownership in our study were lower than national rates in 2010 (31%).[1] In contrast to what others have found, we find that parents with a history of depression were more likely to keep a gun in the home, but note that our respondents were primarily mothers. This finding may therefore reflect differences between our population and populations surveyed in prior studies.[16,17,27] It is particularly important to note that suicide completion is more likely among depressed individuals who keep a firearm in the home.[10] Notably, a substantial proportion of persons with mental illness in our study did not receive pharmacologic or non-pharmacologic treatment. This is relevant because many clinicians and researchers argue that patients with serious mental illness are not at significantly increased risk of violence when treated.[22]

In the context of violence prevention, alcohol and substance use have a substantially greater impact than mental illness.[28,29] Several studies identify substance use behaviors as risk factors for violence.[28,30–32] As reported in past work, we found that parents who are binge drinkers[31] or use illicit drugs are substantially more likely to keep a firearm in the home, though not more likely to acquire a firearm if one were not already present.

Our finding of high rates of firearm ownership in the homes of families with risk factors for self-harm or other violence—as reported primarily by mothers—provides support for professional society recommendations—including those published by the American College of Physicians—about preventive firearm screening,[5] and recommendations for lethal means restrictions.[33,34] The impact of these counseling recommendations on firearm-related injury needs to be studied, but the risk of self-harm associated with firearm ownership in persons with serious mental illness—much less prevalent than other forms of mental illness—is a particularly compelling concern.[35] The results of our longitudinal analysis could also be used to expand professional society recommendations, since many families with risk factors for self-harm or other violence acquire a firearm each year.

A principal limitation of our study is that we assessed mental health and behavioral risk factors for self-harm or other violence in a single parent, with 93% of these parents being female; many families have two parents, and we did not capture characteristics of partners. Related to this, nearly all of the responding parents were female, so our survey may not adequately reflect the potential impact of risk factors in men. In our assessment of parental depression or anxiety, some parents may have had remission of their symptoms, and some may not have been receiving treatment for this reason. However, anxiety disorders are frequently chronic and unremitting, with low rates of recovery,[36] while depression is generally episodic with high rates of relapse.[37,38] The differing structure of our depression (any history) and distress (current) questions may also explain why there was not significant overlap between these two characteristics. An additional risk factor that we did not assess is intimate partner violence. It is widely recognized that the presence of a gun in the home increases the likelihood of gun-related morbidity and mortality among women in abusive relationships.[39,40] Study participants lived primarily in three metropolitan areas, so caution should be exercised in generalizing to other settings, and many families chose not to participate in the survey, though we incorporated weights to account for design and nonresponse. Further, our measures were gathered through self-report; errors or inaccuracies

in self-report could therefore affect our results. This may particularly be a concern for questions about firearm ownership and could be explained by changes in respondents' knowledge of or willingness to answer questions about firearms. Underreporting of firearm ownership could also potentially lead to under- or over-estimation of our measures of association, depending on the pattern of underreporting and the true prevalence of firearm ownership.

In conclusion, families with risk factors for self-harm or other violence—as reported primarily by mothers—generally have a similar or modestly higher likelihood of keeping or newly acquiring a firearm in the home when compared with families without risk factors. Treatment interventions for many of the prevalent risk factors we assessed can be effective, so preventive policy initiatives and clinical guidelines, including those supporting lethal means restrictions, may reduce firearm-related morbidity, but more research is needed to determine which interventions would be most effective in achieving this aim.

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What's New

Families with risk factors for self-harm/violence have a modestly greater probability of having a firearm in the home when compared with families without risk factors. This may have implications for preventive policy initiatives and clinical guidelines aimed at reducing firearm-related morbidity.

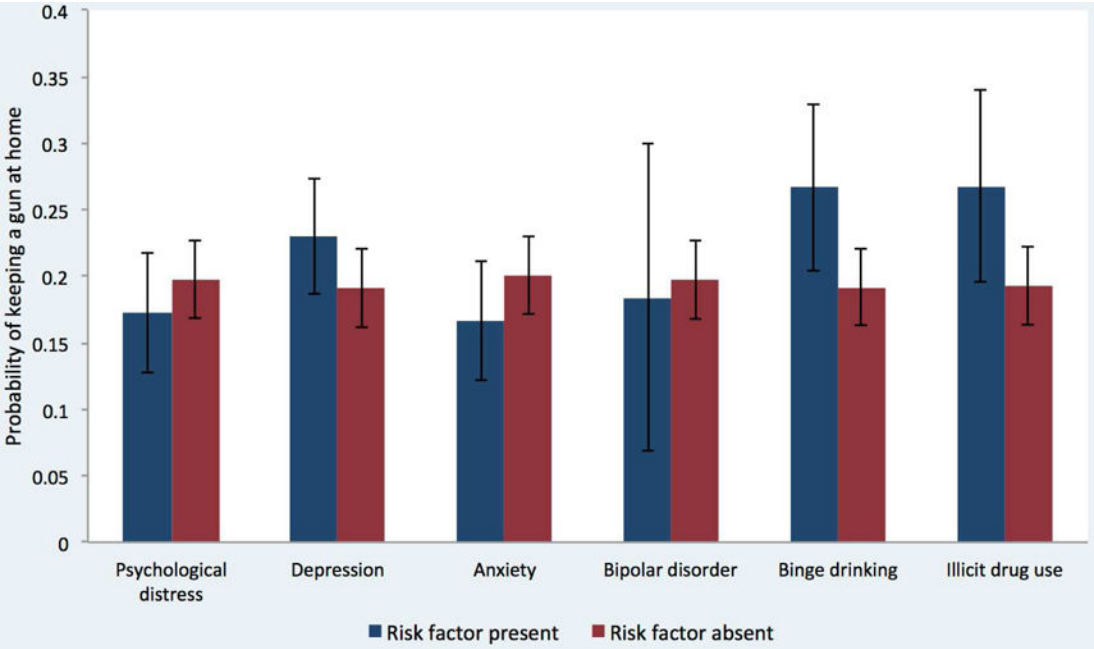

Figure 1.

Adjusted marginal probability of keeping a gun in the home, by presence or absence of risk factors. Error bars represent 95% Confidence Interval.

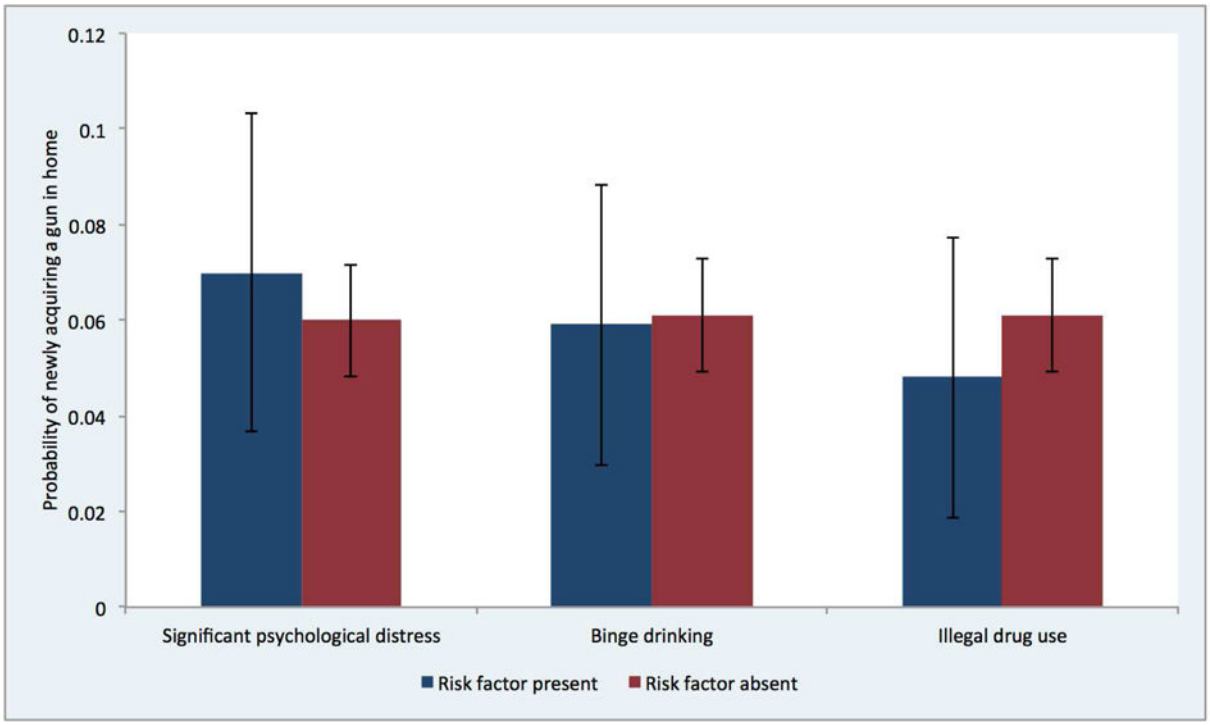

Figure 2.

Adjusted three-year marginal probability of newly acquiring a gun in the home from T2 to T3, by presence or absence of risk factors. Error bars represent 95% Confidence Interval.

Table 1a

Time periods for variables used in multivariate logistic regression models

	Model	
Variables	**Adjusted odds of keeping a gun in the home, T3**	**Adjusted odds of newly acquiring a gun in the home, from T2 to T3**
Keep a gun in home	T3	T2 *, T3
City	T1	T1
Parent's ethnicity	T3	T2
Parent's age	T3	T2
Parent's sex	T3	T2
Presence of male in home	T3	T2
Highest household education	T1	T1
Household income	T3	T2
Marital status	T3	T2
Neighborhood safety	T3	T2
Significant psychological distress	T3	T2
Depression diagnosis	T3	–
Anxiety diagnosis	T3	–
Bipolar disorder diagnosis	T3	–
Binge drinking	T3	T2
Illicit drug use	T3	T2

Note: T1, August 2004 to September 2006; T2, August 2006 to September 2008; T3, January 2010 to June 2011. Depression, anxiety, and bipolar disorder diagnoses were unavailable at T2.

*Parents who already owned a firearm at T2 were excluded from these analyses of longitudinal firearm acquisition by T3

Table 1b

Characteristics of parent participants

	No. of participants	Overall cohort (N=4,251), %*
City		
Birmingham	1,345	31
Houston	1,445	34
Los Angeles	1,461	34
Parent's gender		
Female	3,919	93
Male	332	7
Parent's ethnicity		
White	1,111	24
Black	1,492	29
Hispanic	1,411	42
Other	237	5
Parent's age		
18 to 35 years	532	13
36 to 45 years	2,015	50
46 years or older	1,704	37
Highest household education		
8th grade or some high school	732	23
High school diploma or GED	845	22
Some college	1,149	25
College degree	1,466	30
Household income		
<$25,000	1,403	37
$25,000–$49,999	1,100	28
$50,000–$99,999	851	19
≥$100,000	780	15
Married		
Yes	2570	63
No	1675	37
Neighborhood safety		
Completely safe	1,023	25
Fairly safe	2,242	50
Somewhat dangerous	845	21
Extremely dangerous	141	3

Abbreviation: GED, general equivalency diploma.

*Values are given as percent of participants and may not sum to 100 because of rounding.

Table 2

Prevalence and adjusted odds of keeping a gun in the home [*†]

	No. of participants	Prevalence of having a gun in the home, %	Odds ratio	95% CI	P value	Adjusted OR	95% CI	P value
All participants	4,251	19.6						
Significant psychological distress								
Yes	360	10.5	**0.45**	**0.31 to 0.66**	**<0.001**	0.79	0.54 to 1.16	0.23
(No)	3,891	20.6	(1.00)			(1.00)		
Depression diagnosis								
Yes	576	23.6	**1.32**	**1.04 to 1.66**	**0.02**	**1.36**	**1.04 to 1.77**	**0.02**
(No)	3,675	19.0	(1.00)			**(1.00)**		
Anxiety diagnosis								
Yes	445	21.6	1.15	0.85 to 1.56	0.38	0.74	0.51 to 1.09	0.13
(No)	3,806	19.4	(1.00)			(1.00)		
Bipolar disorder diagnosis								
Yes	58	19.8	1.01	0.49 to 2.08	0.98	0.89	0.34 to 2.35	0.82
(No)	4,193	19.6	(1.00)			(1.00)		
Binge drinking								
Yes	317	20.8	1.08	0.75 to 1.55	0.67	**1.75**	**1.14 to 2.68**	**0.01**
(No)	3,934	19.5	(1.00)			(1.00)		
Illicit drug use								
Yes	223	20.2	1.04	0.70 to 1.54	0.84	**1.75**	**1.12 to 2.76**	**0.01**
(No)	4,021	19.6	(1.00)			(1.00)		

Abbreviations: CI, confidence interval; OR, odds ratio

[*] Multivariate regression models adjusted for sociodemographic factors, including site, parent ethnicity, parent age, highest household education, and household income

[†] Values for which p<0.05 are bolded

Table 3

Three-year incidence and adjusted odds of newly acquiring a gun in the home, from T2 to T3[*†]

	No. of participants	Prevalence of newly acquiring a gun in the home, %	Odds ratio	95% CI	P value	Adjusted OR	95% CI	P value
All participants	3,436	6.1						
Significant psychological distress								
Yes	363	4.6	0.70	0.40 to 1.23	0.22	1.2	0.68 to 2.11	0.54
No	3,073	6.4	1.00			1.00		
Binge drinking								
Yes	261	5.1	0.82	0.45 to 1.49	0.51	0.94	0.51 to 1.74	0.85
No	3,175	6.2	1.00			1.00		
Illicit drug use								
Yes	201	4.8	0.76	0.39 to 1.49	0.42	0.76	0.38 to 1.55	0.46
No	3,235	6.2	1.00			1.00		

Abbreviations: CI, confidence interval; OR, odds ratio

[*]Multivariate regression models adjusted for sociodemographic factors, including site, parent ethnicity, parent age, highest household education, and household income

[†]Depression, anxiety, and bipolar disorder diagnoses were not included in the firearm acquisition model because they were only available at T3.