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## Article

Firearm access and adolescent health: Safety in numbers?<sup>☆</sup>Samantha H. Chung<sup>a,b,c</sup>, Christopher Biely<sup>b,c</sup>, Rebecca Dudovitz<sup>b,c,\*</sup><sup>a</sup> Marlborough School, USA<sup>b</sup> Department of Pediatrics, David Geffen School of Medicine at UCLA, USA<sup>c</sup> Children's Discovery & Innovation Institute, UCLA Mattel Children's Hospital, USA

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## ABSTRACT

Access to firearms and perceived unsafe school environments are associated with negative adolescent health outcomes. Whether widespread acceptance of firearms alters these associations, however, is unknown. To address this literature gap, we examined whether peer acceptance of firearms moderates associations between personal firearm access and health outcomes. In 2018–2019, we analyzed Wave I of the National Longitudinal Study of Adolescent to Adult Health (collected 1994–1995) to assess personal firearm access and school-level percentage of firearm access, using weighted multilevel analyses with interactions to determine associations among personal access, school-level percentage of access, and adolescent depression, suicidality, general health, and perceived school safety. Models controlled for age, sex, race, region, urbanicity, family structure, parental income and education level, school type, school size, and school quality. Results showed that personal firearm access was associated with depression (OR 1.20  $p = 0.03$ ), suicidal ideation (OR 1.73,  $p < 0.001$ ), and perceiving school as unsafe (OR 1.59,  $p < 0.001$ ). A higher school-level percentage of access, however, was associated with lower rather than higher odds of perceiving school as unsafe (OR 0.83,  $p = 0.003$ ). With interaction terms included, the association between personal access and suicidal ideation was weaker when school-level access was more common. Similarly, the association between school-level access and poor general health was negative among students with personal access but positive among students with no access. These findings suggest firearm access is a complex social phenomenon. In a low-access environment, personal firearm access may signify a high-risk physical and mental state. In schools where access is common, however, personal access may signify social belonging, possibly mitigating some potential negative health effects. Although evidence that firearm access is harmful remains clear, local norms may have a substantial moderating impact.

## Introduction

One-third of households in the U.S. with children under 18 have been reported to keep firearms in the home (Johnson, Coyne-Beasley, & Runyan, 2004). Living with a firearm in the home increases the likelihood of firearm-related accident and injury within the home (Kellermann, Somes, Rivara, Lee, & Banton, 1998) and is associated with higher risk for adolescent suicidal ideation and suicide attempts (Hemenway, 2011). While most literature on firearm access during childhood and adolescence focuses on the associations between adolescent firearm access and physical health outcomes such as homicide (Hepburn & Hemenway, 2004; Miller, Hemenway, & Azrael, 2007), suicide (Florentine & Crane, 2010; Knopov, Sherman, Raifman, Larson, & Siegel, 2019), and accidental firearm-related death (Miller et al., 2007), a 2017

study by Kim et al. found that access to firearms at home was also associated with reduced perceived school safety and increased depressive symptoms, particularly for adolescent girls (Kim, 2018).

Few studies, however, examine the relationship between health and broader “secondhand” environmental exposure to firearms, independent of personal access. Literature indirectly suggests that such a relationship may be plausible. For instance, several negative mental health outcomes such as depression have been shown to be associated with adverse childhood experiences (Danese et al., 2009), including neighborhood violence and exposure to violence (Fowler, Tompsett, Braciszewski, Jacques-Tiura, & Baltes, 2009). Likewise, deviant behavior among children, adolescents, and young adults is associated with exposure to community violence (Gorman-Smith, Henry, & Tolan, 2004). Neighborhoods with high levels of community violence are also associated

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with lower perceptions of safety among children and adolescents (Buckner, Beardslee, & Bassuk, 2004; Overstreet & Braun, 2000). While exposure to firearms and exposure to violence may be correlated, the relationship between environmental exposure to firearms (measured as community-level firearm access) during adolescence and mental health remains unknown.

Proximity to firearms in an adolescent's school, neighborhood, town, or state may have a different association with adolescent health than personal access. On one hand, the presence of many firearms within an adolescent's community might lead to worse mental health due to a heightened sense of community-level threat. In this context, a high concentration of firearm owners might be a marker for an unsafe community or might pose a direct threat to community safety. The adoption of stricter state firearm laws, for instance, has been associated with improvements in school climate and perceptions of safety (Ghani, Hawkins, & Baum, 2019).

On the other hand, strong community support for firearms might lessen the negative mental health effects of access to firearms at home. Although a higher level of firearm ownership within one's community is associated with a lower perception of safety among adults, firearm ownership in a community may also be a marker for shared experiences and values (Kleck, 1997). People whose parents owned one or more firearms or grew up living with a firearm in the home are more likely to own firearms as adults (Bordua & Lizotte, 1979). Adolescents with parents who own firearms are also more likely to have a positive experience with firearms, as their parents are more likely to involve their children in firearm-related hobbies (such as hunting and target shooting), and these children are more likely to become firearm owners themselves and continue firearm-related hobbies as adults (Cretacci & Hendrix, 2015; Kleck, 1997). Therefore, the shared experience of firearm ownership and access may increase a community bond and local sense of belonging. In this case, living in a high firearm-access environment might contribute to better mental health for those who also have personal access to firearms.

James S. Coleman's "Social Capital in the Creation of Human Capital" illustrates the theory of social capital, in which networks of relationships, trust, and social norms facilitate an individual's action or the collective action of a community (Coleman, 1988). Furthermore, the presence of social capital has been shown to be associated with positive health outcomes. The community relationships shown through social capital are associated with fewer risk behaviors, such as smoking and binge drinking (Bolin, Lindgren, Lindström, & Nystedt, 2003). Social capital from family and school relationships are also negatively associated with delinquent behavior (Dufur, Hoffmann, Braudt, Parcel, & Spence, 2015). The theory of social capital could apply to the health outcomes of firearm access. For one, if widespread access to firearms leads to worse individual mental health, community-wide firearm access could be a sign of lower levels of social capital. However, if widespread access strengthens community bonds, this access might increase social capital within a community, decreasing the likelihood of poor health outcomes.

Given the recent rise in mass school and other shootings, widely covered by the media, and given that adolescence is a period when physical and mental health both predict and influence patterns of health in adulthood, the impact of not only individual but community-wide access to firearms on adolescent health is of special concern (Sawyer et al., 2012). To fill this gap, we sought to understand the associations between environmental exposure to firearms and adolescent health, and whether those associations differ for those with and without personal access to firearms.

## Methods

### Study population

We performed a secondary analysis of Wave I of the National

Longitudinal Study of Adolescent to Adult Health (Add Health), a longitudinal, nationally representative school-based study of students in the U.S. in grades 7–12 as of the 1994–95 school year (Klein, 1997). We used data from the Wave I in-home interview regarding respondents' individual characteristics, health and perceived access to firearms and school administrator survey, which captures school characteristics. The analytic sample included 18,712 individuals in 132 schools with complete data on the primary outcome (depression), primary predictors (individual firearm access and school-level firearm access), and sample weight. The sample averages 142 students per school, with a range from 20 to 1687 students.

### Measures

Our primary outcome for this analysis was depression, given its previously documented associations with personal firearm access (Kim, 2018). We also examined the additional outcomes of suicidal ideation, general health, and perceived school safety.

**Depression:** Depression was based on the 10-item Center for Epidemiologic Studies Depression Scale (CES-D), a validated measure of depressive symptoms (Irwin, Haydari, & Oxman, 1999; Radloff, 1991). We created a dichotomized variable from the CES-D score, based on the clinical cut-off for depression risk (Radloff, 1977), with  $\geq 11$  points considered "high-risk for depression."

**Suicidal ideation:** Suicidal ideation is associated with personal firearm access among adolescents (Miller, Barber, White, & Azrael, 2013; Miller & Hemenway, 1999; Rivara, 2015). We created a dichotomous variable for suicidal ideation based on responding affirmatively to the question, "During the past 12 months, did you ever seriously think about committing suicide?"

**General health:** Personal firearm access is associated with multiple negative physical and mental health outcomes. General health, believed to reflect both physical and mental health, was measured via the survey question "In general, how is your health?" We created a dichotomous measure of poor general health from this five-category variable, with those answering "fair" and "poor" considered to have poor general health.

**Perceived school safety:** There is an association between personal firearm access and low perceived school safety (Kim, 2018). Perceived school safety was measured via the question, "How strongly do you agree or disagree with the following statement? I feel safe in my school." We created a dichotomous measure of low perceived school safety from this five-category variable, with those answering "disagree" and "strongly disagree" considered to have low perceived school safety.

**Primary predictors:** Our primary predictors were self-reported individual access to a firearm and school-level access to a firearm. We created a dichotomous variable for individual firearm access based on responding affirmatively to the question, "Is a gun easily available to you in your home?" For school-level access, we calculated the weighted percentage of participants at each school who reported individual firearm access. For ease of presentation, each unit for the school-level access variable in regression analyses corresponded to 10 school-level access percentage points.

**Covariates:** These covariates included age, biological sex, race/ethnicity (non-Hispanic White, African American, Hispanic, other), region (West, Midwest, South, Northeast), urbanicity (urban, suburban, rural) (Wright & Marston, 1975), family structure (two biological parents, two parents, single parent, other), household income (\$0–\$24,000, \$25,000–\$49,000, \$50,000–\$74,000, \$75,000 or more, missing) and education level (did not graduate from high school, graduated from high school/GED, some college, bachelor's degree, above bachelor's degree (Cao, Cullen, & Link, 1997), school type (public, private), school size (1–400 students, 401–1000 students, 1001–4000 students), and school quality (school-level measures). As used in our prior study (Dudovitz et al., 2016), the school quality variables included average daily attendance (75–89%, 90–94%, and  $\geq 95\%$ ), average percentage of students

promoted, parent association involvement (0–14% participation, 15–29% participation, 30–100% participation, no parent association), and teacher retention (percentage of full-time classroom teachers that had worked at their school for five years or more).

### Statistical analysis

We analyzed each of the four outcomes in relation to both personal firearm access and percentage of students at school with firearm access, controlling for covariates. Data analysis took place from July 2018–September 2019. To address whether associations between personal firearm access and health varied by social context, we then included an interaction term in each model equal to personal firearm access \* school-level firearm access. Because there is a strong social and cultural association between male sex and firearm ownership (Hill, Howell, & Driver, 1985; Stroud, 2012) and sex differences in perceived safety and attitudes toward firearms (Miller, Azrael, & Hemenway, 2000; Patten, Thomas, & Viotti, 2013), we also explored sex stratified models to test associations separately for boys versus girls. In addition, we explored models stratified by type of firearm (specifically handgun, rifle, and shotgun) to test whether associations differed by usage pattern.

Add Health uses a “nested” sampling design (sampled students are “nested” within sampled schools). Analyses with both individual-level (personal firearm access) and school-level (percentage of firearm-owning students) variables that statistically incorporate this nesting are often preferable to standard single-level analyses. Therefore, we used mixed-effects logistic regression models with random intercepts for school for the analysis. We used the “svy” suite of commands in STATA Corp (Version 14) to account for the three survey design elements: stratification, clustering, and weighting. Missing data reduced the analytic sample by roughly 10% in the various models. Much of this missingness was due to school-level variables that required schools to have operated at least 5 years by Wave 1, thus failing to meet missing-at-random assumptions needed for valid imputation. This study was approved by the [redacted for review process] Institutional Review Board.

### Results

Weighted demographics of the 18,712 adolescents in our analytic sample were similar to those of the overall Add Health sample. As seen in Table 1, 24% of students reported having easy access to a firearm in the home. The percentage of students within each school who had access to firearms ranged from 0% to 70% with an average of 24% (SD 15%). 19% of students reported depressive symptoms in the past week, while 13% of students reported suicidal ideation in the last 12 months. 7% of students reported being in fair or poor health, and 13% of students reported feeling unsafe at school.

#### Associations between adolescent firearm access and health

Results from the main analysis, where each outcome was regressed on both individual-level and school-level firearm access controlling for covariates, are seen in Table 2. Individual-level firearm access was associated with increased odds of depressive symptoms (OR 1.20,  $P = 0.03$ , 95% CI 1.02–1.43), suicidal ideation (OR 1.73,  $P < 0.001$ , 95% CI 1.50–2.00), and perceiving school as unsafe (OR 1.59,  $P < 0.001$ , 95% CI 1.31–1.92). The percentage of students with easy firearm access within one’s school, however, was associated with decreased odds of perceiving school as unsafe (OR 0.83 for each 10-percentage point unit of easy school-level access,  $P = 0.003$ , 95% CI 0.74–0.94). Neither individual nor school-level access to firearms were associated with general health.

Results from models including an interaction between easy firearm access and percentage of students at school with easy firearm access are seen in Table 3. We found significant interactions between individual and school-level firearm access for models examining suicidal ideation

**Table 1**  
Individual- and school-level sample characteristics.

	Percentage/Mean (N/S.D.)
<b>Individual-level variables</b>	
Male sex	50.7
Race/Ethnicity	
African-American	15.9
Hispanic	11.2
White	67.2
Other	5.8
Family structure	
2 biological parents	53.5
2 parents	17.3
Single parent	23.4
Other	5.8
Household income	
0–24K	22.7
25K–49K	25.8
50K–74K	17.8
75K+	10.7
Missing	23.0
Parent education	
Did not graduate from HS	10.1
Graduated from HS/GED	32.1
Went to college but did not graduate	21.6
Graduated from college	24.4
Professional training beyond college	11.9
Age in years	15.5 (1.8)
School size	
Large (1001–4000)	37.8
Medium (401–1000)	44.7
Small (1–400)	17.5
School type (public)	93.2
Urbanicity	
Rural	15.5
Suburban	58.4
Urban	26.2
Region	
Midwest	31.3
Northeast	13.7
South	38.5
West	16.5
<b>School-level variables</b>	
Average daily attendance	
95% or more	37.8
90–94%	45.8
75–89%	16.5
Parent association involvement	
30–100%	26.4
15–29%	20.5
0–14%	39.7
Missing	13.4
Teacher retention	66.7 (21.0)
Average % of students promoted	93.1 (7.3)
<b>Main predictors and outcomes</b>	
Easy firearm access (individual-level)	24.3
% of students with easy firearm access (school-level)	24.4 (14.7)
Depressive symptoms	18.8
Suicidal ideation	13.2
Fair/poor general health	7.0
Perceives school as unsafe	12.8

S.D. = Standard deviation.

(interaction term OR 0.91,  $P = 0.02$ , 95% CI 0.84–0.98) and poor general health (interaction term OR 0.85,  $P = 0.004$ , 95% CI 0.76–0.95). When interaction terms were included in the models, the association between individual firearm access and suicidal ideation was weaker when attending a school where firearm access was more common. Similarly, the association between school-level access and poor general health was negative among students with personal access but positive among students with no access (Fig. 1).

The stratified analysis of suicidal ideation showed a lower odds ratio for individual firearm access among schools with high access to firearms (OR 1.61,  $P < 0.001$ , 95% CI 1.35–1.91) compared to schools with low access to firearms (OR 2.02,  $P < 0.001$ , 95% CI 1.62–2.51). The stratified

**Table 2**  
Associations between adolescent firearm access and health.

	AOR	P-value	95% C.I.
<b>Depressive symptoms</b>			
Easy firearm access (individual-level)	1.20	0.03	1.02–1.43
% of students with easy firearm access (school-level, unit = 10 percentage points)	0.96	0.23	0.91–1.02
<b>Perceives school as unsafe</b>			
Easy firearm access (individual-level)	1.59	<0.001	1.31–1.92
% of students with easy firearm access (school-level, unit = 10 percentage points)	0.83	0.003	0.74–0.94
<b>Suicidal ideation</b>			
Easy firearm access (individual-level)	1.73	<0.001	1.50–2.00
% of students with easy firearm access (school-level, unit = 10 percentage points)	0.95	0.12	0.89–1.01
<b>Fair/poor general health</b>			
Easy firearm access (individual-level)	1.00	0.99	0.79–1.27
% of students with easy firearm access (school-level, unit = 10 percentage points)	1.07	0.20	0.97–1.17

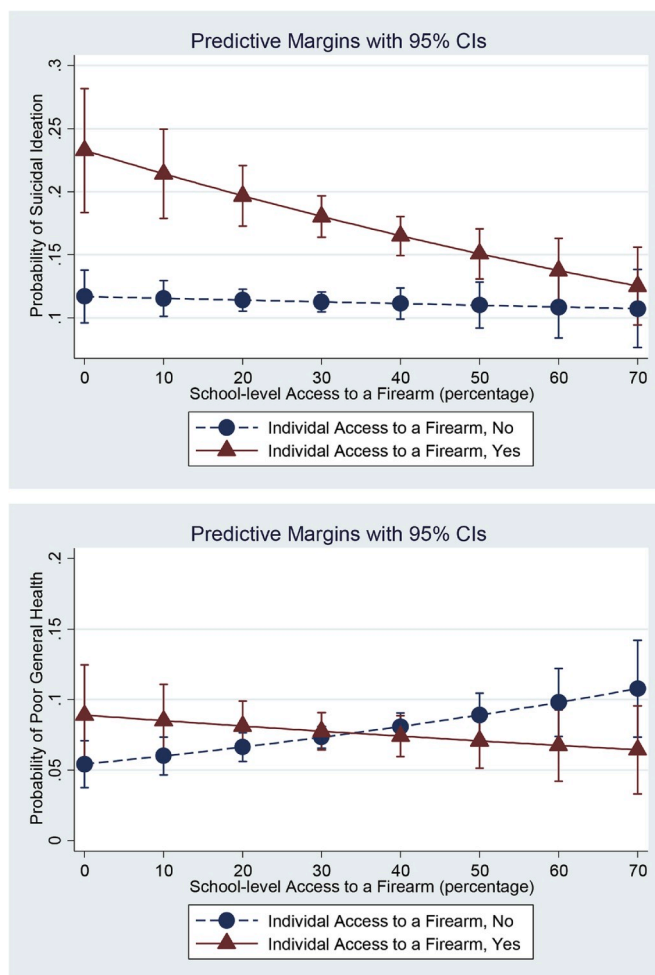
AOR = adjusted odds ratio; 95% C.I. = 95% confidence interval. Separate multilevel weighted models were performed for each outcome including both individual and school-level access to firearms as predictors. All models controlled for sex, race, family structure, household income, parent education, age, school size, school type, urbanicity, region, average daily attendance, parent association involvement, teacher retention, and average % of students promoted.

**Table 3**  
Associations between adolescent firearm access and health with interactions between individual and school-level firearm access.

	AOR	P-value	95% C.I.
<b>Depressive symptoms</b>			
Easy firearm access (individual-level)	1.40	0.08	0.97–2.02
% of students with easy firearm access (school-level, unit = 10 percentage points)	0.98	0.53	0.91–1.05
Easy firearm access * % of students with easy firearm access	0.96	0.40	0.86–1.06
<b>Perceives school as unsafe</b>			
Easy firearm access (individual-level)	2.01	0.002	1.30–3.09
% of students with easy firearm access (school-level, unit = 10 percentage points)	0.86	0.004	0.78–0.95
Easy firearm access * % of students with easy firearm access	0.92	0.30	0.79–1.08
<b>Suicidal ideation</b>			
Easy firearm access (individual-level)	2.34	<0.001	1.77–3.11
% of students with easy firearm access (school-level, unit = 10 percentage points)	0.99	0.71	0.92–1.06
Easy firearm access * % of students with easy firearm access	0.91	0.02	0.84–0.98
<b>Fair/poor general health</b>			
Easy firearm access (individual-level)	1.74	0.009	1.15–2.63
% of students with easy firearm access (school-level, unit = 10 percentage points)	1.12	0.02	1.01–1.23
Easy firearm access * % of students with easy firearm access	0.85	0.004	0.76–0.95

AOR = adjusted odds ratio; 95% C.I. = 95% confidence interval. Separate multilevel weighted models were performed for each outcome including both individual and school-level access to firearms plus an interaction term of individual X school-level access to firearms. All models controlled for sex, race, family structure, household income, parent education, age, school size, school type, urbanicity, region, average daily attendance, parent association involvement, teacher retention, and average % of students promoted.

analysis of poor general showed a lower odds ratio for individual firearm access among schools with high access to firearms (OR 0.93, P = 0.62, 95% CI 0.70–1.24) compared to schools with low access to firearms (OR 1.17, P = 0.37, 95% CI 0.83–1.64). We did not find significant interactions between individual and school-level firearm access for models examining depression (interaction term OR 0.96, P = 0.40, 95% CI 0.86–1.06) and low perceived school safety (interaction term OR 0.92, P = 0.30, 95% CI 0.79–1.08). The stratified analysis of depression showed



**Fig. 1.** Predicted probabilities of suicidal ideation and poor general health by interacted individual and school-level access to firearms. Figures demonstrate the predicted probability of a) suicidal ideation and b) poor general health for individuals with and without access to firearms as the percentage of students at their school with access to firearms increases.

a lower odds ratio for individual firearm access among schools with high access to firearms (OR 1.17, P = 0.08, 95% CI 0.98–1.40) compared to schools with low access to firearms (OR 1.32, P = 0.10, 95% CI 0.94–1.84). The stratified analysis of low perceived school safety showed a lower odds ratio for individual firearm access among schools with high access to firearms (OR 1.54, P = 0.001, 95% CI 1.21–1.96) compared to schools with low access to firearms (OR 1.76, P < 0.001, 95% CI 1.30–2.38).

Finally, we conducted sex stratified secondary analyses and analyses stratified by type of firearm (e.g., handgun), which revealed findings similar to our main analyses described above (not shown).

**Discussion**

This is the first study to investigate the relationships among school-level access to firearms, personal firearm access, and adolescent health. Overall, we found that personal firearm access was associated with higher levels of depressive symptoms, suicidal ideation, and perceiving school as unsafe. This is consistent with a wealth of studies demonstrating that access to firearms is associated with poor physical and mental health, for both children and adults (Florentine & Crane, 2010; Hemenway, 2011; Hepburn & Hemenway, 2004; Kellermann et al., 1998; Miller et al., 2007). In schools where firearm access is more common, however, some of these negative health associations were

weaker. Specifically, students attending a school where firearm access was more common had lower odds of perceiving school as unsafe, and personal firearm access in these schools was less strongly associated with suicidal ideation and poor general health. Similarly, for students without personal firearm access, attending a school where access was common was associated with worse rather than better general health.

Overall, these findings suggest that school-level firearm access is associated with adolescent health, but in complex and perhaps counter-intuitive ways. These associations not only may differ from associations between personal firearm access and health but may also vary based on discordance between school-level and personal firearm access, with higher discordance associated with worse outcomes. It is possible, then, that some of these complex findings might best be explained by the potentially beneficial mental health effects of social concordance layered on top of the generally harmful effects of individual firearm access. If we assume that school-level firearm access may indicate greater community-level access, these results may underscore the importance of considering larger community-level public health implications of firearm policies aimed at individuals, and vice versa. In a previous nationally representative study investigating community firearm exposure and health, approximately 50% of adult respondents reported that they would feel less safe if more people in their community owned firearms, while only 14% reported that they would feel safer (Miller et al., 2000). Although this finding indicates a broadly negative perception of how firearms relate to safety, it likely masks differences among local communities and even differences among residents within local communities that may contribute to the current debate regarding firearm-related policy. Understanding how community levels of firearm access differentially affect those with and without personal access and vary across communities may be critical to engaging in more productive and locally targeted discussions around firearm-related policies.

In our study, for instance, the somewhat harm-mitigating associations between school-level firearm access and health, particularly for students with personal access to firearms, may reflect more familiarity with firearms in settings generally deemed less threatening. In higher-access communities, where firearms may often be kept for hunting or sport, firearms may not create perceptions of an unsafe environment as strongly as they may in lower-access communities. Our study was unable to test this hypothesis directly—indirectly, we found no obvious differences in associations between firearm access and health by urbanicity and type of firearm. However, adolescents who grow up living with a firearm in the home are more likely to own firearms as adults (Bordua & Lizotte, 1979), which might indicate normalization of firearms through multi-generation firearm ownership. Furthermore, in communities where firearms are kept primarily for hunting or sport rather than for protection, firearm owners in those communities may be more likely to store their firearms safely (Berrigan, Azrael, Hemenway, & Miller, 2019). Firearm owners themselves have expressed that communities such as hunting and outdoors groups are some of the most effective ways to communicate safe firearm storage practices (Crifasi, Doucette, McGinty, Webster, & Barry, 2018). Generally accepted practice of safe storage might also contribute to adolescents' lower odds of perceiving their school as unsafe. Although a high concentration of firearm ownership is generally associated with less rather than more safety (Johnson et al., 2004), communities with high levels of firearm access but low levels of violence and crime may not experience the same cognitive links between firearm ownership and lack of safety. Indeed, there may be widespread belief, correct or not, that firearms contribute to rather than detract from personal safety.

There may be another, more speculative possibility as well. Personal firearm access, in the setting of high community firearm access, may be a correlational marker of social belonging. Adolescents whose parents and friends own firearms may have a more positive experience with firearms, as these parents and friends may be more likely to create shared experiences that happen to include firearms (Cretacci & Hendrix, 2015; Kalesan, Villarreal, Keyes, & Galea, 2016). Associating firearms with

these positive experiences, these children may be more likely to become firearm users themselves and continue firearm-related hobbies with others in their social networks as adults (Cretacci & Hendrix, 2015; Kleck, 1997). Therefore, firearm access may over time become associated with a sense of belonging, which may contribute to increased perceived safety and attenuated negative mental health effects. Firearm access in a high-access community may also be a marker of social capital, as firearm access might lead to shared experiences and social concordance. Likewise, in communities with low levels of firearm access, having no personal firearm access may be associated with more positive mental health effects because, in this opposite context where few people own firearms, lack of personal firearm access may also signify social belonging. Firearm ownership and access in this low-access setting might be a marker of social difference or deviance, and a sign of low social capital. Future research could examine whether other potential markers of social concordance, such as being poorly educated in a poorly educated community or being a single parent in a community with high rates of single parent families, might also be associated with health outcomes.

### Limitations

This research is limited by the variables available in Add Health. In particular, we lacked variables that would have allowed us to directly examine 1) reasons for firearm access (e.g., hunting, sport, protection) and 2) a more comprehensive social milieu with respect to firearms. These variables would have allowed us to explore whether associations between firearm access and health differed by more precise aspects of the environmental context than by more general markers such as school-level access, sex, firearm type, and urbanicity.

The research is limited for other reasons, as well. Because the data are survey-based and self-reported, they may also be subject to social desirability bias. The survey question also assesses perceived firearm access, which may not reflect actual firearm access. Thus, the research only considers participants who are aware of a firearm in their home as having firearm access. In addition, Add Health participants were in grades 7–12 as of the 1994–95 school year. Data from this group may not be entirely representative of adolescents in the U.S. today. Perceptions related to the individual and societal impact of access to firearms on health may change over time. This is especially important to consider, given the occurrence of high-profile school and other public shootings in recent years (Ghani et al., 2019; Rowhani-Rahbar & Moe, 2019) and widespread access to social media that may magnify the impact of these traumatic events on adolescent mental health (Schuster et al., 2001). It is therefore unknown whether our findings would be replicated in the current era. Similarly, it is unknown whether our findings would be different if firearm access away from home was also considered. In addition, because this is an observational study, we cannot determine whether the relationships between our predictors and outcomes are causal in nature. Finally, while we attempted to control for a host of contextual factors, it is possible that there are unmeasured factors that could confound our results.

### Conclusions

Our findings suggest that the social context of firearm access may have meaningful, measurable, and complex associations with health. Personal firearm access in general has more negative than positive associations with mental health. Moreover, regardless of mental health, in-home firearm access is known to be associated with firearm-related injuries and death. Nevertheless, in schools where firearm prevalence is high, the negative mental health impacts of firearms may be lessened or invisible to students themselves. How clinicians approach individual counseling around firearm use and exposure and how child health advocates approach public policy with respect to firearms may need to acknowledge and account for this complex relationship between

individual health and community norms.

### Declaration of competing interest

The authors have no conflicts of interest or funding sources to disclose. Samantha Chung has no financial disclosures; Christopher Biely has no financial disclosures; and Rebecca Dudovitz has no financial disclosures.

### CRedit authorship contribution statement

**Samantha H. Chung:** Conceptualization, Data curation, Writing - original draft. **Christopher Biely:** Data curation, Formal analysis, Methodology, Writing - review & editing. **Rebecca Dudovitz:** Conceptualization, Data curation, Methodology, Supervision, Writing - review & editing.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssmph.2020.100568>.

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