



Published in final edited form as:

Prev Med. 2022 December ; 165(Pt A): 107286. doi:10.1016/j.yjmed.2022.107286.

## Understanding factors associated with firearm possession: Examining differences between male and female adolescents and emerging adults seeking emergency department care

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### Abstract

Firearm possession increases the likelihood of hospital visits among adolescents and emerging adults for both males and females. To better inform prevention practices, we examine data among adolescents and emerging adults (A/EAs; ages 16 to 29) presenting to an urban emergency department for any reason to understand the differences in firearm possession between males and females ( $N = 1312$ ; 29.6% male; 50.5% Black). Regression identified firearm possession correlates, such as male sex (AOR = 2.26), firearm attitudes (AOR = 1.23), peer firearm possession (AOR = 9.84), and community violence exposure (AOR = 1.02). When stratified by sex (e.g., male vs female), regression results yielded differences in correlates for firearm

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#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.yjmed.2022.107286>.

possession: in males, peer firearm possession (AOR = 8.96) were significant, and in females, firearm attitudes (AOR = 1.33) and peer firearm possession (AOR = 11.24) were significant. An interaction between sex and firearm attitudes demonstrated that firearm attitudes were differentially associated with firearm possession between female and male A/EAs (AOR = 1.28). Overall, we found that females are more likely to endorse retaliatory firearm attitudes, and both males and females are highly influenced by their perception of peer firearm possession. These results help inform prevention strategies across multiple settings, especially for hospital-based violence interventions, and suggest that tailored approaches addressing differences between male and female A/EAs are appropriate when addressing firearm violence and injury risk among A/EAs.

## Keywords

Firearm possession; Sex differences; Adolescents and emerging adults; Firearm injury; Injury prevention; Firearm violence

## 1. Introduction

Firearms are the leading mechanism of death among U.S. adolescents and emerging adults (A/EAs, age 16–29) (Johns Hopkins Center for Gun Violence Solutions, 2022). Approximately 62% of firearm deaths resulting from homicides in 2020 according to data from the Wide-ranging Online Data for Epidemiologic Research (WONDER) system of the CDC, known as CDC WONDER. Further, recent research has indicated that there is an increase in firearm possession/usage being reported by females (Oliphant et al., 2019). Further, non-fatal firearm injuries are responsible for ~66,160 Emergency Department (ED) visits among A/EAs annually (2010–2020), with the majority (81.4%) resulting from firearm assaults (Carter et al., 2020). Such injuries are associated with significant health and social consequences, including repeat firearm and non-firearm assaults (Cunningham et al., 2015; Rowhani-Rahbar et al., 2015), future firearm violence involvement (Carter et al., 2015; Rowhani-Rahbar et al., 2015), long-term health/physical disabilities (DiScala and Sege, 2004), substance use disorders, mental health issues (e.g., PTSD), and criminal justice involvement (i.e., arrest/incarceration) (Carter et al., 2018; Cunningham et al., 2009; DiScala and Sege, 2004; Greenspan and Kellermann, 2002; Rowhani-Rahbar et al., 2015; Walton et al., 2017). Disparities exist, with firearm homicide rates among non-Hispanic Black A/EAs 13 times higher than non-Hispanic White A/EAs, 4.3 times higher than Hispanic A/EAs (Massetti and David-Ferdon, 2016). Such disparities largely result from structural factors, with data highlighting that firearm homicide is concentrated within urban communities with a legacy of racial segregation, redlining, and economic disinvestment (Branas et al., 2009; Cheng et al., 2006; Cook, 1981; Durant et al. 1995; DuRant et al., 1997; Felson and Steadman, 1983; Loughran et al., 2016; Lowry et al., 1998; McDowall et al., 1992; Pelletier and Pizarro, 2019; Pickett et al., 2005; Pizarro et al., 2021). Disinvestment in urban communities of color is also associated with a lack of prevention services (Bottiani et al., 2021). The economic costs of firearm injury are substantial, estimated at \$229 billion annually (Spitzer et al., 2019) when inclusive of acute and longterm medical costs, lost work/productivity, and costs for criminal justice proceedings. Given the burden of disease

and resulting costs, national organizations have called for a renewed focus on addressing firearm violence through evidence-based prevention science (Butkus et al., 2018; Ranney et al., 2017; Bauchner et al., 2017).

Researchers have found that A/EAs who carry and/or own firearms, as well as the peers around them, are at increased risk for serious and/or fatal firearm injury outcomes (Branas et al., 2009; DuRant et al., 1997; Lowry et al., 1998; Pickett et al., 2005; Cheng et al., 2006; Cook, 1981; Felson and Steadman, 1983; Loughran et al., 2016; McDowall et al., 1992). Further, while data collected among A/EAs living in neighborhoods with elevated violence shows that firearms are largely acquired outside of legal channels for the purposes of protection (Carter et al., 2013; Webster et al., 2009), they are also frequently carried and used in aggressive or risky ways against peers and/or partners during low level altercations that escalate to lethal violence (Carter et al., 2013; Carter et al., 2020; Carter et al., 2017). As a result, reducing firearm possession among A/EAs has been identified as a key research priority for primary prevention programs. Researchers have highlighted risk factors for firearm possession, including substance use, prior violence involvement (i.e., victimization, aggression), peer firearm carriage, and community violence exposure (Beardslee et al., 2018; Carter et al., 2013; Cunningham et al., 2010; Luster and Oh, 2001; Reid et al., 2017; Spano and Bolland, 2011; Steinman and Zimmerman, 2003; Vaughn et al., 2012). While researchers have identified heterogeneity in firearm carriage rates by sex, few have examined how risk factors for possession may differ between male and female A/EAs (Oliphant et al., 2019). Traditionally, firearm possession rates among A/EAs have been highest among males and relatively low among females (Gunn and Boxer, 2021; Oliphant et al., 2019). Recently, there has been a reported increase in female firearm possession among those living in urban settings with high levels of alcohol and drug use and high levels of reported violent and delinquent behavior (Oliphant et al., 2019; Vaughn et al., 2017). Despite these findings, exploration into differences in sex and firearm possession has been lacking. Further, most studies have been focused on school or criminal justice populations (Cao et al., 2008; Steinman and Zimmerman, 2003; Vaughn et al., 2012; Hemenway et al., 2011), with few researchers examining possession among A/EAs seeking healthcare (Rowhani-Rahbar et al., 2015; Carter et al., 2015; Carter et al., 2017). Emergency Departments (EDs) are important settings for primary prevention programs, especially as they provide access to an underserved population that may not be attending school or involved in the criminal justice system (Cunningham et al., 2009). As hospitals are increasingly offering violence prevention programs to A/EAs who are at an increased risk for negative violence outcomes, understanding differences in firearm possession risk factors among male and female A/EAs within a healthcare sample will better inform both our understanding of differences in firearm possession rates and how to tailor future prevention efforts to address these differences for this population (Cunningham et al., 2019).

Given these gaps in the literature, we examine data from an ED-based screening sample to characterize: (1) firearm possession among A/EAs seeking ED treatment; and, (2) differences in firearm possession risk factors between male and female A/EAs. Our approach is guided by the findings of prior research (Carter et al., 2013; Carter et al., 2020; Carter et al., 2017) and rooted in Socio-Ecological Theory (Bronfenbrenner, 1992;

Bronfenbrenner, 1977), examining risk factors across individual, peer, and community levels.

## 2. Methods

Data are from a cross-sectional screening survey conducted among A/EAs seeking ED treatment to assess eligibility for a larger intensive longitudinal daily data trial. Study procedures have been previously described (Carter et al., 2020) and were approved by University of Michigan and Hurley Medical Center (HMC) Institutional Review Boards (IRBs); an NIH certificate of confidentiality (COC) was obtained.

### 2.1. Setting

The study was conducted at HMC, a Level-1 trauma center in Flint, Michigan. HMC provides ED treatment to ~100,000 patients annually. The sample reflects the socio-demographic characteristics of Flint (50–60% Black) (Carter et al., 2020) and is similar to prior studies at this site (Carter et al., 2020). Flint rates of violence are comparable to those in other de-industrialized urban centers (e.g., Camden, Oakland, Baton Rouge), with a rate of 46.5 homicides and 1050 violent crimes per 100,000, and higher than the national average of 6.5 homicides and 399 violent crimes per 100,000 (Federal Bureau of Investigation, 2019; U.S. Census Bureau, 2018).

### 2.2. Population

A/EAs (age 16–29) seeking ED treatment for any reason (e.g., injury, abdominal pain) were eligible for the screening survey. Approximately 8% ( $N = 110$ ) were seeking treatment due to a violent injury that was the result of a physical fight (i.e., cut, burn, bruise, broken bone, muscle strain, knife or gunshot wound, etc.). Those seeking care for a sexual assault, child maltreatment, suicidal ideation/attempt, serious mental illness (e.g., schizophrenia), or cognitive impairment (e.g., intoxication) were excluded due to either inability to consent or the need for significant psycho-social services that precluded participation. A/EAs in active police custody were not eligible to participate due to inability to provide consent. Mean survey completion time was 34.8-min ( $SD = 27.7$ ).

### 2.3. Procedures

Recruitment proceeded 7 days/week during high-volume hours (2 pm–12 am) from 7/10/2017 to 6/25/2018 (excluding holidays). Research assistants identified potentially eligible patients using the ED electronic tracking board, approaching them in consecutive order (by triage time) to explain the study and obtain written consent (and/or assent with parental/guardian consent). Following consent, participants self-administered the screening survey via a computer tablet. Survey administration was paused for medical evaluation and/or procedures. To enhance privacy/accuracy, family/friends were not allowed to observe/participate. Remuneration for the survey completion was a ~\$1 gift (e.g., earbuds, fidget spinners, etc.).

## 2.4. Measures

**2.4.1. Firearm possession**—The dependent variable is made up of two items from the Tulane Study (Sheley and Wright, 1993) measuring firearm carriage and possession that we have used in prior work (Carter et al., 2013). The dependent variable is made up of two items from the Tulane Study (Sheley and Wright, 1993) measuring firearm carriage and possession that we have used in prior work (Carter et al., 2013). We conceptualized possession as a combination of firearm carriage and ownership to reflect instances where the firearm may be carried or shared between A/EAs, but not considered “owned” by a A/EA. Participants were asked whether they owned and carried a firearm with them (including in their car) in the past three months. Response options were dichotomized for analysis (yes/no), with an affirmative answer to either item coded as past-3-month firearm possession (Carter et al., 2013; Sokol et al., 2021).

**2.4.2. Socio-demographics**—Age, sex (male/female), and race/ethnicity were collected using measures from the Adolescent Health Study (Bearman et al., 1997), Data on Treatment Outcomes (DATOS) Study (United States Department of Health and Human Services, National Institutes of Health, National Institute on Drug Abuse, 1993–1995) and/or National Institutes of Health (NIH) guidelines on race/ethnicity reporting (National Institutes of Health, 2001). For analysis, race/ethnicity was collapsed to Black/African American (vs. other) due to a low number of participants that reported different races and ethnicities. Socio-economic status (SES) was assessed with two items (Bearman et al., 2005) asking if they or their parent/guardian had received public assistance (e.g., welfare, bridge card). For analysis, items were collapsed to indicate any public assistance (yes/no).

### 2.4.3. Individual-level factors

**2.4.3.1. Substance misuse:** Alcohol, marijuana, illicit drug (i.e., cocaine, hallucinogens, inhalants, methamphetamine, street opioids) and non-medical prescription (i.e., opioids, sedatives, stimulants) drug use were measured using the Alcohol Use Disorders Identification Test – Consumption, or AUDIT-C, (Saunders et al., 1993; Chung et al., 2000) and Alcohol, Smoking and Substance Involvement Screening Test, or ASSIST, (Group, 2002; Humeniuk et al., 2008). Non-medical prescription drug use was defined as taking more than prescribed, taking someone else’s medications, and/or taking medications when you were sad or to get high. Consistent with prior literature (Chung et al., 2000), alcohol misuse was defined as an AUDIT score  $\geq 4$  for males and  $\geq 3$  for females; similarly, drug misuse was defined as ASSIST scores  $\geq 4$  on any drug subscale (Group, 2002; Humeniuk et al., 2008). Given multicollinearity, items were collapsed for analysis to indicate any past 3-month substance misuse (yes/no).

**2.4.3.2. Firearm attitudes:** Attitudes towards using firearms as a means of solving perceived/actual disputes and/or to seek retaliation, were assessed with three items from the Youth Gun Survey (Sheley and Wright, 1995). Items measured responses on a 5-point Likert scale (strongly agree/strongly disagree) and items were coded/summed so that higher scores indicated a greater willingness to use firearms.

**2.4.3.3. Violence.:** Eleven items from the Adolescent Health Survey (Bearman et al., 2005) assessed past 3-month frequency of *violent offending* (e.g., threatened/used firearms) and *violent victimization* (e.g., jumped/beaten up, gun threats). Responses ranged from 0 (never) to 6 (20+ times) and separate, standardized summary scores for violent offending and violent victimization were created for analysis.

#### **2.4.4. Peer- and community-level factors**

**2.4.4.1. Peer firearm possession.:** A single item (Sheley et al., 1992) assessed how many of their peers own or carry firearms using a 4-point Likert scale (none to all-of-them). For analysis, responses were dichotomized (yes/no), indicating if any peers owned/carried firearms.

**2.4.4.2. Community violence exposure.:** Twelve items from the community violence subscale of the “Things I have seen and heard survey” (Richters and Saltzman, 1990) were used to measure past-3-month violence exposure (e.g., heard gun shots). Responses options ranged from never (0) to many times (3); a standardized summary score (0–36) was created for analysis.

### **2.5. Analysis**

Bivariate and multivariable analyses comparing the independent risk factors and the dependent variable of interest, firearm possession, were first examined among the entire sample (Hidalgo and Goodman, 2013). Independent variables were selected and added to the hierarchical model based on socio-ecological theory (Bronfenbrenner, 1992; Bronfenbrenner, 1977), as well as prior analyses characterizing risk factors for firearm possession (Branas et al., 2009; Carter et al., 2013; Pelletier and Pizarro, 2019; Pizarro et al., 2021). Hierarchical modeling was used as it allows for clarity at multiple stages and allows for the simultaneous estimation effects at multiple levels (Bostwick, 2021). To understand how such factors may differ by sex, we examined the same socio-ecological variables within separate hierarchical models stratified by sex (male, female). Finally, as firearm attitudes was the only independent variable that differentiated male and female firearm possession in the sex stratified models, we examined an interaction between sex and firearm attitudes and firearm possession to assess whether factors associated with firearm possession differ between males and females. Of note, we conducted a sensitivity analysis repeating the analysis after excluding individuals indicating their primary motivation for ownership was hunting/recreational use or for employment ( $n = 40$ ). Results from the sensitivity analysis did not differ from models analyzed among the entire sample. Thus, we report the results of models conducted among the full sample.

## **3. Results**

Overall, 1312 A/EAs seeking ED treatment completed the screening survey and were included in the analysis. The recruitment flowchart has been previously published (Carter et al., 2020). During the recruitment sampling frame, 3340 youth within the age range (age 16–29) presented for ED treatment, with 2451 eligible to approach for the screening survey (26.6% excluded). Among those eligible for the screening survey, 1657 youth

were approached by an RA (32.4% missed during visit), with 1312 youth completing the full screening survey and included within the analytic sample (19.2% refusal rate; 1.6% excluded due to partial survey completion). Youth refusing participation were more likely male (22.9%-vs-18.1%;  $p < .05$ ) than those included in the analytic sample. No other socio-demographic differences were noted among youth refusing participation and the analytic sample. Within the analytic sample, mean age was 22.2 years old, 29.6% were male, 50.5% were Black/African-American, and 56.3% were receiving public assistance. In total, 17.0% ( $n = 223$ ) of A/EAs reported past 3-month firearm possession (1 firearm), with males reporting higher percentages than females (27.6%-vs-12.6%; OR = 2.65, CI: 1.97–3.57,  $p < .001$ ). Among A/EAs owning/carrying firearms ( $n = 223$ ), the primary reason for possession was protection ( $N = 137$ ; 61.4%), followed by hunting ( $n = 59$ ; 26.5%) and holding the firearm for someone else ( $N = 11$ ; 5.0%). Reasons for firearm possession did not differ by sex (male vs. female).

### 3.1. Factors associated with Firearm Possession

**3.1.1. Bivariate analysis**—Compared to A/EAs without firearms (Table 1), those reporting firearm possession were more likely older and male. No differences were found for race/ethnicity and public assistance. We did find that A/EAs reporting firearm possession had elevated percentage of recent substance misuse, violent offending, and violent victimization compared to those without firearms. They also endorsed more favorable attitudes towards using firearms to solve disputes and/or retaliate for prior offenses. Beyond the individual level, A/EAs with firearms had elevated percentages of peer firearm possession and community violence exposure compared to A/EAs not reporting recent firearm possession.

**3.1.2. Regression**—Hierarchical logistic regression models examining predictors of firearm possession among the entire sample are presented in Table 2. Socio-demographic predictors were entered first, followed by individual, peer, and community variables. Model 4 shows that compared to those without firearms, A/EAs with firearms were more likely to be male, endorse attitudes favoring firearm use to solve disputes/retaliate, perceive their peers possess firearms, and have been exposed to greater community violence even after controlling for age, race, and SES. Substance misuse, violent victimization, and violent offending were not associated with firearm possession in the final model (Model 4).

### 3.2. Factors associated with firearm possession stratified by sex

**3.2.1. Regression (Males Only)**—Table 3 shows the hierarchical logistic regression models examining firearm possession among male A/EAs ( $n = 344$ ) only. After controlling for socio-demographic, individual, peer, and community level factors, peer firearm carriage remained the only factor associated with firearm possession in the final model (model 4). Firearm attitudes, recent violence behaviors, and community violence exposure were not associated with male firearm possession. Substance misuse, which was significant at the individual-level (Model 2), was no longer significant in the final model after controlling for peer and community-level factors.

**3.2.2. Regression (Females Only)**—Table 4 shows the hierarchical logistic regression models examining firearm possession among female A/EAs ( $n = 890$ ) only. After controlling for socio-demographic, individual, peer, and community level factors, peer firearm carriage and firearm attitudes were associated with female firearm possession in the final model (Model 4). Similar to males, recent violence behaviors and community violence exposure were not associated with female firearm possession. Substance misuse, which was significant in Models 2 and 3, was not significant in the final model after controlling for community-level factors.

**3.2.3. Final regression model (Entire Sample)**—Results from the sex stratified models suggested a potential interaction between sex and firearm attitudes. This hypothesis was tested by adding an interaction term to the regression model for the entire sample (Table 1, Model 5). Within this model, the interaction term (AOR = 1.3, 95% CI = 1.0–1.6;  $p < .05$ ) indicated that endorsing more favorable attitudes towards firearm use was more strongly associated with firearm possession among females than male A/EAs.

## 4. Discussion

Our findings regarding the influence of peer firearm possession are consistent with those observed in national adolescent samples (Chavez et al., 2022), and are especially worrisome considering recent data indicating that firearms are now the leading mechanism of death for U.S. adolescents and emerging adults, with 65.0% of these deaths resulting from interpersonal violence (Goldstick et al., 2022). Among an ED screening sample, we found that 17.0% of A/EAs reported recent firearm possession, with male A/EAs more than twice as likely to report having firearms when compared to female A/EAs. Of note, while possession percentages in our sample are lower than those for higher risk assault-injured ED youth, where up to a quarter report owning/carrying firearm, (Carter et al., 2013) percentages in our sample were notably higher than those (7.0%) for a similar ED screening populations collected at the same site a decade earlier (Cunningham et al., 2010). Further, while firearm possession percentages have increased among both male and female A/EAs and are higher for male than female A/EAs in both samples, the magnitude of the differences between male and female A/EA firearm possession appears to have narrowed during the past decade, with a marked increase in female A/EA firearm possession when compared to earlier percentages. While these findings may be influenced by subtle differences between the samples and measures used, they consistently indicate an increasing trend.

Further, our results also highlight the importance of considering healthcare settings for primary prevention approaches early before A/EAs progress in the trajectory of violence involvement to more severe behaviors. Predictors associated with firearm possession within the full sample, including male sex, profirearm attitudes, peer firearm carriage, and community violence exposure largely mirror the findings of prior analyses examining firearm possession, as well as risky firearm behaviors (e.g., threats/use), among healthcare (Carter et al., 2013; Carter et al., 2017, Carter et al., 2020, Cunningham et al., 2010, Loh, 2010) and non-healthcare-based samples (Cao et al., 2008; Steinman and Zimmerman, 2003; Vaughn et al., 2012; Hemenway et al., 2011). In contrast to prior analyses (Carter et al., 2013; Cunningham et al., 2010; Reid et al., 2017; Spano and Bolland, 2011), we did not find

an association between prior violence involvement (i.e., victimization, violent offending) and firearm possession. This likely reflects differences in the timeframe examined (i.e., past 3-months vs. 12-months) (Cunningham et al., 2010) and/or the population (Carter et al., 2013; Reid et al., 2017; Spano and Bolland, 2011), with studies among higher severity samples (e.g., assault-injured youth, criminal justice populations) further along the trajectory of violence involvement more likely to find an association between prior violence and firearm possession. While substance misuse was associated with firearm possession when examined at the individual level, this association was suppressed after the introduction of peer firearm ownership/carriage, and was non-significant when examining risk factors across all socio-ecological levels. This likely reflects prior data demonstrating that multiple risk behaviors (e.g., substance use, firearm carriage) often cluster within high-risk negative peer groups (Fujimoto and Valente, 2015; Schaefer et al., 2013). Future research examining the relative influence of both individual and peer substance misuse and firearm carriage on individual level firearm outcomes may help clarify this association.

Our finding that negative peer influences were a salient factor for both male and female A/EAs emphasize the importance of addressing peer influences within primary prevention efforts addressing firearm behaviors among both adolescent groups. This finding, which is consistent with non-stratified models in prior research, reflects the important role that peer influences have during adolescence and emerging adulthood (Goldstick et al., 2017; Steinberg and Monahan, 2007; Goldstick et al., 2017). Researchers have reported that risky firearm behaviors are often clustered within a small peer group or network, and that firearm violence outcomes are often concentrated within small area neighborhood hotspots, mirroring an infectious disease context (Hemenway et al., 1996; Hemenway et al., 2011; Braga et al., 2010; Papachristos et al., 2013). Data suggest that this clustering of firearm behaviors among small social networks leads to an overestimation by A/EAs of firearm ownership/carriage among the general population (Hemenway et al., 2011) and is a significant factor underlying the finding within prior qualitative studies that “fear someone is carrying” and “need for protection” are key motivations for A/EA firearm ownership (Carter et al., 2013; Mateu-Gelabert, 2002).

Within the stratified models, more favorable attitudes towards using firearms to solve conflicts and/or retaliate for prior altercations was a significant factor differentiating female, but not male firearm possession in our separate and total sample interaction models. It is also notable that male A/EAs in our sample had higher levels of pro-firearm attitudes regardless of firearm possession status when compared to their female counterparts (see supplementary tables). Taken together, such findings may indicate that while underserved male A/EAs believe that firearms are an appropriate means for settling fights and/or retaliating for prior altercations, this belief in and of itself did not appear to alter the decision about whether to own/carry firearms. Yet, for female A/EAs such attitudinal factors may be an important component in regard to this decision. Given higher overall firearm possession among males in our sample, combined with the finding that a greater number of males report having peers that own/carry firearms than females (regardless of their own firearm status) (Hemenway et al., 1996; Hemenway et al., 2011; Braga et al., 2010; Papachristos et al., 2013), such attitudinal factors may not influence their decision to own/carry their own firearms because they have greater access to firearms when needed through their peer networks. Nevertheless,

given that retaliation is a primary motivation for firearm conflicts (Carter et al., 2015; Carter et al., 2013; Carter et al., 2017; Copeland-Linder et al., 2007) and that health behavior theory (Gielen and Sleet, 2003) suggest altering pro-violence attitudes is a fundamental aspect of reducing violent aggression and associated firearm risk behaviors, our findings suggest that prevention-based interventions should continue to address beliefs and attitudes around the use of firearms to resolve conflict and should tailor the situational context of this content to be relevant by differences among A/EA sub-groups by sex.

#### 4.1. Implications for practice

Findings from the present study have several implications for firearm injury prevention programs. First, firearm possession prevalence among this screening sample seeking ED treatment highlights the need for improved clinical screening tools to identify A/EAs at increased risk for engaging in risky firearm behaviors and experiencing negative injury-related outcomes. Our results highlight the importance of ensuring that such screening tools are focused broadly among both male and female A/EAs and are not limited solely to patients seeking assault-injury treatment (with only 8.4% of our sample presenting for a violent injury). While prospective validation studies are needed, researchers have recently identified promising new tools such as the SaFETy Score for identifying future firearm violence risk (Goldstick et al., 2017). Expanding the application of such tools across a variety of medical settings may help identify underserved populations earlier in the trajectory of their violence involvement and navigate them towards appropriate prevention services. Second, our finding that firearm possession prevalence has increased substantially among an underserved urban population, and that neighborhood violence exposure was a significant factor underlying possession in the combined model highlights the importance of increasing community violence prevention efforts. This is especially true considering data demonstrating that need for protection remains the most salient motivation underlying firearm ownership/carriage (Oliphant et al., 2019). Researchers have reported that neighborhood interventions addressing blight remediation and vacant lot greening have been efficacious reducing firearm assault, violent crime, and community stress, while increasing perceptions of safety (Branas et al., 2016; Kondo et al., 2018; Branas et al., 2011; Heinze et al., 2018; Garvin et al., 2013; Kondo et al., 2016). Expanding on these efforts, as well as understanding what additional community-engaged prevention efforts are efficacious in reducing community violence may reduce the perception among underserved A/EAs that carrying/owning firearms is necessary to remain safe.

A third implication for practice suggests attention to tailoring prevention strategies by sex may be necessary. The finding that peer firearm ownership/carriage was the most salient risk factor for firearm possession among both male and female A/EAs, combined with prior research showing that youth often overestimate the number of their peers that carry/own firearms (Hemenway et al., 2011), demonstrates the importance of including normative feedback within these behavioral interventions. Further, such interventions may benefit by a focus on enhancing positive peer influences, especially considering data demonstrating that such affiliations may help reduce firearm carriage (Sokol et al., 2020), counter normative misperceptions regarding firearm carriage, and enhance engagement in prosocial activities (Hemenway et al., 2011; Neighbors et al., 2006; Walters and Neighbors, 2005; Altermatt

and Pomerantz, 2005). Finally, as noted, findings from sex-stratified analyses highlight the importance of ensuring firearm injury prevention efforts address risks for both male and female A/EAs and may benefit from tailoring of intervention content around pro-firearm attitudes to their specific context.

## 4.2. Limitations

Several study limitations should be acknowledged. First, data are from a single urban Level-1 ED and may not be representative of rural/suburban populations. Yet, as the socio-demographics of the sample reflect the Flint population, our findings are likely generalizable to similar communities experiencing elevated firearm violence rates (Federal Bureau of Investigation, n.d.). Second, while self-report data collection is a potential limitation, researchers (Gray and Wish, 1998; Thornberry and Krohn, 2000; Buchan et al., 2002; Brener et al., 2003; Turner et al., 1998; Wright et al., 1998; Webb et al., 1999; Harrison et al., 2007) have shown the reliability/validity of this approach when privacy/confidentiality are assured, as was done in this study. Third, the male sample was notably smaller than the female sample, potentially raising concerns about the power to detect the influence of all the independent variables. Despite this, we did find some notable differences in firearm possession by sex. Future studies will need to replicate findings within a larger stratified sample. Finally, the cross-sectional nature of the study precludes causal findings, particularly around whether the differences for firearm attitudes by sex was a causal factor underlying firearm possession. Future research that examines the nature of these relationships within longitudinal studies is needed. Despite such limitations, our findings make an important and novel contribution to the existing literature.

## 5. Conclusions

Among a clinical ED screening sample, rates suggest a significant and increasing prevalence in firearm possession during the past decade among both male and female A/EAs. Our analysis also identified that while peer influences remained the largest predictor of ownership/carriage among the sample, differences emerged by sex when considering the role of firearm attitudes as a factor influencing firearm possession. Findings have implications for future individual and community level efforts to address the complex, but preventable public health problem of firearm violence.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgments

The authors wish to acknowledge Jessica Roche for her assistance in manuscript preparation.

All persons who have made substantial contributions to the work reported in the manuscript (e.g., technical help, writing and editing assistance, general support), but who do not meet the criteria for authorship, are named in the Acknowledgements and have given us their written permission to be named. If we have not included an Acknowledgements, then that indicates that we have not received substantial contributions from non-authors.

### Funding sources and/or disclosures

Dr. Pelletier's work on this manuscript was funded by her fellowship funding under NIH/NICHD Award #R24HD087149. This work was funded by NIH/NIDA K23DA039341, and in part by NIH/NCATS UL1TR000433. The ideas in this report are those of the authors and do not necessarily represent the official position of the funding agencies. No honoraria, grants or other form of payment were received for producing this manuscript. Research reported in this publication was supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development of the National Institutes of Health under Award Number T32HD108054. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

### Abbreviations:

<b>A/EAs</b>	Adolescents and Emerging Adults
<b>CDC</b>	Center for Disease Control
<b>ED</b>	Emergency Department
<b>URCI</b>	University Research Center
<b>IFIP</b>	Institute for Firearm Injury Prevention

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**Table 1**

Sample Characteristics for Individuals with and without Firearm Possession.

<b>N = 1312</b>				
	<b>Firearm possession (n = 223; 17%)</b>	<b>No firearm possession (n = 1089; 83%)</b>	<b>Total (N = 1312)</b>	<b>OR (95% CI)</b>
Socio-demographics				
<b>Age, mean (SD) *</b>	22.68 (3.67)	22.11 (3.76)	22.20 (3.75)	1.04 (1.00–1.08) *
<b>Male sex ***</b>	107 (48.00)	281(25.80)	388 (29.60)	2.65 (1.97–3.57) ***
African American	103 (46.20)	559 (51.30)	662 (50.50)	0.81 (0.61–1.09)
Public assistance	117 (52.50)	622 (57.10)	739 (56.30)	1.25 (0.92–1.68)
Individual-level factors				
<b>Drug or alcohol misuse ***</b>	156 (70.0)	525 (48.2)	681 (51.9)	1.34 (0.92–1.95) ***
<b>Firearm attitudes (mean, SD) ***</b>	4.40 (1.85)	3.82 (1.27)	3.92 (1.40)	1.28 (1.17–1.40) ***
<b>Violent offending (mean, SD) ***</b>	1.56 (3.87)	0.52 (1.51)	0.69 (2.14)	1.19 (1.12–1.26) ***
<b>Violent victimization (mean, SD) ***</b>	0.68 (1.76)	0.26 (0.96)	0.33 (1.15)	1.26 (1.14–1.40) ***
Peer-level factors				
<b>Peer firearm carriage ***</b>	193 (86.50)	389 (35.70)	582 (44.40)	11.58 (7.73–17.34) ***
Community-level factors				
<b>Community violence exposure, mean (SD) ***</b>	12.96 (10.94)	7.83 (8.55)	8.70 (9.20)	1.06 (1.04–1.07) ***

Note:

\*  
p < .05\*\*  
p < .01\*\*\*  
p < .001

all continuous variables are sum scores. OR: Odds ratio.

Table 2

Hierarchical Logistic Regression for Firearm Possession with Demographics, Individual, Peer, Community Level, and Interaction Variables.

Full Sample (N = 1234)						
Covariates	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)	Model 5 OR (95% CI)
Age	1.05* (1.01–1.09)	1.05* (1.01–1.09)	1.04 (0.99–1.09)	1.04 (0.99–1.08)	1.04 (0.99–1.09)	1.04 (0.99–1.09)
Male	2.81*** (2.06–3.84)	2.52*** (1.82–3.48)	2.29*** (1.61–3.26)	2.26*** (1.58–3.21)	2.34*** (1.64–3.33)	2.34*** (1.64–3.33)
African American	0.86 (0.63–1.17)	0.71* (0.51–0.99)	0.95 (0.67–1.36)	0.86 (0.59–1.24)	0.85 (0.59–1.23)	0.85 (0.59–1.23)
Public assistance	0.95 (0.69–1.30)	0.86 (0.62–1.19)	0.86 (0.61–1.23)	0.84 (0.59–1.20)	0.81 (0.57–1.16)	0.81 (0.57–1.16)
Drug or alcohol misuse	–	2.13*** (1.51–2.99)	1.48* (1.03–2.14)	1.37 (0.94–1.99)	1.35 (0.93–1.96)	1.35 (0.93–1.96)
Firearm attitudes	–	1.22*** (1.10–1.36)	1.24*** (1.10–1.40)	1.25*** (1.09–1.39)	0.83 (0.55–1.24)	0.83 (0.55–1.24)
Violent victimization	–	1.02 (0.88–1.19)	1.09 (0.92–1.29)	1.05 (0.89–1.25)	1.05 (0.89–1.25)	1.05 (0.89–1.25)
Violent offending	–	1.13** (1.03–1.23)	1.07 (0.97–1.18)	1.05 (0.96–1.16)	1.06 (0.96–1.16)	1.06 (0.96–1.16)
Peer firearm carriage	–	–	10.40*** (6.70–16.13)	9.84*** (6.33–15.30)	10.11*** (6.48–15.75)	10.11*** (6.48–15.75)
Community violence exposure	–	–	–	1.02 <sup>A</sup> (1.00–1.05)	1.03* (1.01–1.05)	1.03* (1.01–1.05)
Sex and firearm attitudes interaction	–	–	–	–	1.28* (1.01–1.62)	1.28* (1.01–1.62)

Note:

\* p 0.05

\*\* p 0.01

\*\*\* p 0.001

full model chi-square:  $\chi^2(11) = 275.47, p < .001$ . OR: Odds ratio.

<sup>A</sup>Note: Before rounding, CI was not inclusive of 1.00 (CI = 1.0034, OR = 1.0193).

**Table 3**

Hierarchical Logistic Regression for Firearm Possession with Demographics, Individual, Peer, and Community Level Variables, **Males Only** ( $n = 344$ ).

Covariates	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Age	<b>1.07*</b> (1.01–1.34)	1.06 (1.00–1.13)	1.04 (0.98–1.12)	1.04 (0.97–1.11)
African American	0.78 (0.48–1.26)	0.64 (0.38–1.07)	0.81 (0.46–1.42)	0.72 (0.40–1.30)
Public assistance	1.04 (0.64–1.68)	0.99 (0.60–1.64)	0.97 (0.56–1.67)	0.96 (0.55–1.67)
Drug or alcohol misuse	–	<b>1.71*</b> (1.01–2.89)	1.18 (0.66–2.12)	1.05 (0.57–1.93)
Firearm attitudes	–	1.17 (0.98–1.40)	1.13 (0.93–1.37)	1.10 (0.91–1.34)
Violent victimization	–	1.13 (0.88–1.46)	1.15 (0.88–1.51)	1.09 (0.83–1.43)
Violent offending	–	1.04 (0.91–1.20)	1.00 (0.87–1.15)	1.00 (0.87–1.15)
Peer firearm carriage	–	–	<b>9.35***</b> (4.77–18.32)	<b>8.96***</b> (4.56–17.61)
Community violence exposure	–	–	–	1.03 (0.99–1.06)

Note:

\*  
p 0.05

\*\*  
p 0.01

\*\*\*  
p 0.001

full model chi-square:  $\chi^2(9) = 81.90, p < .001$ . OR: Odds ratio.

**Table 4**

Hierarchical Logistic Regression for Firearm Possession with Demographics, Individual, Peer, and Community Level Variables, **Females Only** ( $n = 890$ ).

Covariates	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Age	1.03 (0.98–1.09)	1.04 (0.98–1.10)	1.04 (0.98–1.11)	1.04 (0.98–1.11)
African American	0.91 (0.61–1.36)	0.78 (0.51–1.19)	1.09 (0.68–1.73)	0.98 (0.61–1.58)
Public assistance	0.89 (0.59–1.35)	0.77 (0.50–1.20)	0.78 (0.48–1.25)	0.73 (0.45–1.18)
Drug or alcohol misuse	–	<b>2.43 *** (1.55–3.82)</b>	<b>1.66* (1.02–2.68)</b>	1.55 (0.95–2.53)
Firearm attitudes	–	<b>1.25 *** (1.10–1.42)</b>	<b>1.32 *** (1.13–1.54)</b>	<b>1.33 *** (1.14–1.55)</b>
Violent victimization	–	0.99 (0.82–1.20)	1.09 (0.88–1.34)	1.07 (0.86–1.32)
Violent offending	–	1.18 (1.06–1.32)	1.13 (1.00–1.28)	1.10 (0.97–1.25)
Peer firearm carriage	–	–	<b>11.98 *** (6.62–21.67)</b>	<b>11.24 *** (6.20–20.38)</b>
Community violence exposure	–	–	–	1.03 (1.00–1.05)

Note:

\*  
p 0.05

\*\*  
p 0.01

\*\*\*  
p 0.001

full model chi-square:  $\chi^2(9) = 155.03, p < .001$ . OR: Odds ratio.