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Firearm violence and associated factors among young adults presenting to emergency departments in three cities: Baseline results from Project SPARK

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Abstract

Objective: Recent shifts in U.S. violence dynamics call for updated violence epidemiology among general emergency department (ED) samples of young adults. Using baseline data from a multi-site longitudinal study of firearm violence prediction, we describe violence rates and associated factors.

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Interest-statement

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Declaration of competing interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ypmed.2024.108124>.

Methods: Staff approached age 18–24 entrants to Level-1 trauma centers in three cities (Flint, Seattle, Philadelphia; 7/2021–5/2023). Consenting participants completed a survey including validated measures of violence experience, firearm-related behaviors, substance use, mental health symptoms, peer/parental/familial behaviors, community violence, and attitudes/norms. We described the sample and examined factors associated with firearm assault (victimization/aggression, including threats).

Results: Across sites, 1506 participants enrolled (41.7. % Black; 33.6 % White; 61.4. % female). Half of participants self-reported past-six-month violent victimization and/or aggression; non-partner violence, and violent victimization were most common. Over half of participants self-reported high-risk substance use, and over half screened positive for post-traumatic stress disorder, depression, and/or anxiety. About 14.4 % self-reported past-six-month firearm assault, and 5.9 % self-reported firearm violence (excluding threats). Adjusted analysis showed community violence exposure was most strongly associated with firearm assault; each one-point increase corresponded to a 13.7 % (95 %CI: 10.4 %–16.9 %) absolute increase in firearm assault prevalence. Drug misuse, mental health symptoms, firearm carrying, retaliatory attitudes, prosocial attitudes, and family conflict were also associated with firearm assault.

Conclusions: Violence, including firearm assault, is common among young adults entering urban EDs, and is associated with several psychosocial factors. High rates of substance use and mental health symptoms underscore this as a high-need population. Leveraging this information could help tailor interventions and optimize resource allocation.

1. Introduction

Interpersonal violence is a leading cause of both fatal (Centers for Disease Control and Prevention (CDC), 2024a) and nonfatal (Centers for Disease Control and Prevention (CDC), 2024b) injuries among children and young adults in the United States. Firearm injuries, specifically, disproportionately affects younger Americans, both with regard to fatal and nonfatal injuries (Goldstick et al., 2021; Goldstick et al., 2019a; Kaufman et al., 2021). Moreover, violence among children and young adults is a critical driver of health disparities, with racial and sexual minorities showing substantially higher rates of violence injuries (Centers for Disease Control and Prevention (CDC), 2024c). Those trends extend to firearm violence as well with, for example, Black and Hispanic White Americans showing substantially higher rates of firearm deaths than their Non-Hispanic White counterparts (Rees et al., 2022; Vargas et al., 2023). These disparities reflect broader structural inequalities and non-uniform distribution of social determinants of health (Degli Esposti et al., 2022; Kim, 2019). These facts collectively point to a critical need to leverage all opportunities to reduce youth violence, and firearm violence specifically, and the correspondent health disparities.

Urban emergency departments (EDs) are an important touch point for young people at high risk for violence. Adolescents and young adults entering the ED consistently show higher rates of violence than the general population; for example, the proportion of high school youth reporting past-year fighting has decreased (e.g., 33.2 % in 2001; 18.3 % in 2021) (Centers for Disease Control and Prevention (CDC), 1991–2021), but up to three quarters of adolescents entering the ED report peer violence (Walton et al., 2009), including over

half of those not presenting for assault-related injuries (Bohnert et al., 2015). Furthermore, young people presenting to the ED for violence injuries are at substantial risk for violent re-injury, with over one-third returning within two years, and nearly one-fourth of those presenting for other reasons returned within a year (Cunningham et al., 2015). Not only are adolescents and young adults presenting to the ED at elevated risk for violence, but the visit itself may represent an opportunity to catalyze behavior change. Prior research supports this supposition, with previous successes of ED-based interventions for violence (Walton et al., 2010; Cunningham et al., 2012; Cunningham et al., 2013), and health behaviors such as alcohol use (Barata et al., 2017; Gentilello et al., 2005), and other drug use (Bogenschutz et al., 2014; Madras et al., 2009).

While ED-based violence epidemiology has been studied previously (Cunningham et al., 2015; Carter et al., 2015; Cunningham et al., 2009; Wiebe et al., 2011; Ranney et al., 2016), violence dynamics in the U.S. have shifted in recent years—including firearm violence specifically. Violence mortality has sharply increased in recent years, with rates increasing 23.6 % from 2014 to 2021, driven largely by increases in homicides, which have increased 58.5 % during that time (Centers for Disease Control and Prevention (CDC), 2024d). Although violence mortality rates are uniformly higher across most age groups in 2021 (e.g., relative to 2014), these changes are largest among young people (Centers for Disease Control and Prevention (CDC), 2024d). Trends in firearm violence have been analogous, but more pronounced, increasing 41.7 % from 2014 to 2021, with a correspondent increase of 83.9 % among firearm homicides (Centers for Disease Control and Prevention (CDC), 2024d). Similarly, increases in firearm deaths are most pronounced among young people, as more gravely reflected by the fact that firearm deaths recently overtook motor vehicle crash deaths as the leading cause of death among children and young adults (Goldstick et al., 2022). Taken together, this suggests it is critical to update violence rates—and associated factors—among young people presenting to the ED.

In this report, we describe baseline results from the Screening to Predict Young Adults at Risk for Firearm Violence (SPARK) project, a multi-site prospective longitudinal study of young adults entering the ED that aims to externally validate and improve the SaFETy (Serious fighting, Friend weapon carrying, community Environment, and firearm Threats) score (Goldstick et al., 2017), a four-item screen tool derived to predict future firearm violence risk in the ED. We began by describing rates of different types of violence, substance use, and mental health symptoms. Next, we estimated how sociodemographic, community, and substance use/mental health factors were associated with recent firearm assault experience (shot or threatened, as victim or aggressor). We hypothesized that violence rates among a general ED sample of young adults would be high, and that firearm assault is associated with a number of psychosocial factors measured in the baseline survey.

2. Methods

2.1. Study design and setting

SPARK is a prospective longitudinal study of young adults (age 18–24) presenting to one of four Level-1 trauma centers in three cities—Philadelphia, Seattle, and Flint. Individuals age 18–24 that spoke English and were medically and cognitively able to provide consent were

eligible; those requiring intensive psychosocial services (e.g., presenting for sexual assault, psychosis, active suicidal ideation) or in active police custody were ineligible. Study staff also did not approach individuals with droplet precautions (e.g., for COVID-19). Recruiters identified potentially eligible participants using the electronic health record and approached them in waiting or treatment areas. Eligible participants that signed consent forms were enrolled in the study, which includes ~25–30 min surveys at baseline, 6-months, and 12-months, and prospective medical chart reviews to identify any violence-related injuries occurring in the year following their baseline date. Participants were remunerated \$40 for completing the baseline survey. Recruitment in Seattle occurred from 8/26/2021–5/25/2023, in Philadelphia from 7/26/2021–5/31/2023, and in Flint from 1/24/2022–5/9/2023. A certificate of confidentiality was obtained, and all procedures were approved by the parent IRB (University of Michigan) and the IRB's of the University of Washington and the University of Pennsylvania.

2.2. Measures

We measured past-six-month violence experience using the modified Conflict Tactics Scale (Straus et al., 1996), which queries frequency of eleven different violence exposures, separately for victimization and aggression, and for partner and non-partner violence. We classified violence into three levels—moderate (e.g., pushed/grabbed/shoved, threw something, slapped), severe non-firearm violence (kicked/bit/hit, hit with something, beat up, choked, threatened or attacked with a knife), and firearm assault (which includes both violence *and* firearm threats). We also report the percent self-reporting firearm violence (excluding threats). These measures were all presented as binary indicators of any past-six-month exposure.

In addition to age, race, and gender, measured as described elsewhere (The GenIUSS Group, 2024) to include gender minorities, several other domains of variables were measured using validated instruments:

- Alcohol use: The Alcohol Use Disorder Identification Test (AUDIT-C) three-item questionnaire (Chung et al., 2000) measured past-sixmonth alcohol use, risky use (AUDIT-C ≥ 4 among men; ≥ 3 among women)
- Drug use: We measured past-six-month cannabis use, other illicit drug use (cocaine, street opioids, methamphetamine, inhalants, hallucinogens), and non-medical prescription drug use (sedatives, opioids, stimulants) using the National Institute on Drug Abuse (NIDA) modified Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) (National Institute on Drug Abuse (NIDA), 2024), summarized risky use (defined by ASSIST ≥ 4 on a given substance) (National Institute on Drug Abuse (NIDA), 2024).
- Mental health symptoms: We measured depression using the Patient Health Questionnaire-9 (PHQ-9) (Richardson et al., 2010), anxiety using the Generalized Anxiety Disorder (GAD-7) questionnaire (Spitzer et al., 2006), and post-traumatic stress disorder (PTSD) using the PTSD Checklist-17 (PCL-17) (Lang and Stein, 2005), and summarized them as a binary indicator of a positive screen, using cut points of 10, 10, and 30, respectively, for the total scores. Past

two-week suicidal ideation was ascertained using one item from the Columbia Suicide Severity Rating Scale (Posner et al., 2011) (“In the past two weeks, have you actually had any thoughts of killing yourself?”).

- *Firearms in car/household and firearm carrying*: The past-six-month and lifetime indicator of having firearms in ones car/household was queried using an adapted item from the Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention (CDC), 2021) (e.g., changing “Are there any” to “Have you ever, at any time in your life, kept a firearm in your home or the car, van, or truck you usually drive”). Similarly modified measures queried past-six-month firearm carrying frequency on a seven-point scale taking values of zero (“Never”), one (“Once”), two (“Twice”), three (“3–5 times”), four (“6–10 times”), five (“11–20 times”), and six (“20+ times”).
- *Peer behaviors*: Four items on positive peer behaviors (e.g., college attendance) and seven items negative peer behaviors (e.g., fighting, substance use) were taken from the Flint Adolescent Study (Zimmerman et al., 2002). Both scales were summarized by the mean of the items comprising it. Each scale ranges from zero to four.
- *Peer/parental support*: Peer support was measured by the average of three items from the Flint Adolescent Study (Zimmerman et al., 2002), and parental support was measured by the average of six items from Procidano and Heller’s social support scale (Procidano and Heller, 1983). Each scale ranges from one to five.
- *Family conflict*: The mean of five items from the Flint Adolescent Study (Zimmerman et al., 2002) measured level of family conflict. This scale ranges from one to four.
- *Adverse childhood experiences (ACEs)*: We queried eight ACEs using items from the National Survey on Child Health (The Child and Adolescent Health Measurement Initiative (CAHMI), 2024), summarized as the number of ACEs reported, resulting in a number from zero to eight.
- *Community exposures*: The average of fourteen items from the “Things I’ve seen and heard” survey (Richters and Saltzman, 1990) measured past-six-month crime and violence exposures in the respondent’s neighborhood. This average ranges from zero to three.
- *Retaliatory attitudes*: Seven items from Hill and Noblin (Hill and Noblin, 1991) were averaged to measure the degree to which the an individual had attitudes favoring retaliation. This score ranges from one to four, with higher scores indicating greater belief in/approval of retaliation.
- *Resiliency*: Four items from The Brief Resilient Coping Scale were averaged to measure resilience (Sinclair and Wallston, 2004). This score ranges from one to five.

- *Prosocial attitudes*: Prosocial beliefs were measured by the average of eight items from the Prosociality scale of Caprara et al (Caprara et al., 2005). This scale ranges from one to five.

In addition, we measured the SaFETy score (Goldstick et al., 2017), but given that its distribution, associated factors, and its association with firearm violence was the subject of a separate publication (Goldstick et al., 2024), we do not report that here.

2.3. Statistical analysis

Our analysis began with a description of the recruitment flow, sample characteristics, and some description of the service needs of the sample—violence exposure, substance use, mental health, and ED utilization—stratified by site. Next, we described the prevalence of different levels of violence exposure (moderate, severe non-firearm, firearm) both as victim and aggressor, at each site. Focusing on self-reported firearm assault (i.e., firearm assault experience, as victim or aggressor, including threats) as the outcome variable—we descriptively compared those with-vs-without self-reported firearm assault on peer behaviors, parental/familial environment, community exposures, retaliatory and prosocial attitudes, substance use, and mental health factors associated with firearm assault in this sample. To derive adjusted covariate effects, we used logistic regression. We reported basic lack-of-fit statistics (e.g., Hosmer-Lemeshow test statistic) for that model, and quantified its discriminatory power using the area under the Receiver Operator Characteristic curve (AUROC). To aide interpretation, we reported logistic regression coefficients as marginal effects rather than odds ratios; marginal effects are interpreted here as adjusted differences in the prevalence of self-reported firearm assault rather than relative differences in odds. We used R version 4.4.1. for all data analyses presented.

3. Results

The SPARK recruitment flow is shown in Fig. 1. Among those approached, 25.4 % refused study participation prior receiving the baseline survey. Those refusing prior to baseline were 44.4 % male, and had an average age of 21.4 (SD = 1.9). In total, 1506 young adults enrolled in the study and completed the baseline survey—649 in Seattle (one ED), 318 in Flint (one ED), and 539 in Philadelphia (two EDs). In total, 61.4 % of those completing the baseline survey self-reported as female, 35.9 % male, and 2.7 % non-conforming. Regarding race, the sample is predominantly Black (41.7 %) or White (33.6 %), followed by Multiracial (9.8 %) and Asian (7.2 %). About one-third of the sample was in school. There are differences across sites in these demographics, e.g., Seattle showed a greater proportion male, lower proportion Black, and higher proportion Asian and Multiracial; full demographics by site are in Table 1. Nearly 1-in-5 reported keeping in firearm in their car and/or household in their lifetime, while 1-in-9 reported doing so within the past six months; over 1-in-10 reported past-six-month firearm carriage (Table 1). Of note, among those reporting past-six-month firearm carriage, 35.0 % reporting doing so 20+ times; 68.7 % reported carrying at least “3–5 times”).

3.1. Substance use and mental health symptoms

Nearly half of respondents reported risky cannabis use (ASSIST sum ≥ 4) in the past six months (Table 1); rates were highest at the Flint site (52.7 %) and lowest at the Philadelphia site (40.7 %). Nearly one third of the sample reported risky alcohol use (Table 1); across sites this ranged from 22.3 % (Flint) to 37.8 % (Seattle). A majority (60.5 %) reported risky use of alcohol and/or at least one substance. Positive ASSIST screens (ASSIST sum ≥ 4) for risky illicit drug use and risky non-medical prescription drug use were reported by 7.0 % and 4.1 % of respondents, respectively, with the highest rates seen at the Seattle site (Table 1).

Mental health symptoms were prevalent in the sample. Around one-third screened positive for PTSD, for depression, and for anxiety (Table 1). Over half screened positive for at least one of the aforementioned (50.2 %). Past two-week suicidal ideation was reported by 3.8 % of respondents (Table 1). Each mental health measure showed moderate variability across sites (Table 1).

3.2. Violence rates

Exactly half of respondents reported any past-six-month violence experience, and over 1-in-10 reported a past-six-month ED visit for a violent injury (assault, fighting, or conflict with another person). Non-partner violence was more common than partner violence, and violence victimization was more common than aggression, though even the least common combination—partner aggression—was reported by 17.3 % of respondents (Table 1). Moderate violence was more common than severe non-firearm violence (Appendix Fig. 1), but nearly one-in-four reported some form of severe non-firearm aggression, and over 30 % reported severe non-firearm victimization. Nearly 1-in-7 reported past-six-month firearm assault; non-partner firearm assault, and firearm assault victimization were more common (Appendix Table 1), but over one-quarter of those reporting firearm assault also reported partner firearm assault victimization, and aggression. About 5.9 % self-reported either being shot, or shooting someone else, in the past six months (i.e., removing threats from the firearm assault variable).

3.3. Factors associated with firearm assault experience

Table 2 shows unadjusted contrasts between those with-vs-without self-reported firearm assault. Positive peer behaviors, and both peer and parental support were protective, while negative peer behaviors, family conflict, and ACEs corresponded to increased prevalence of self-reported firearm assault. Community crime/violence exposure showed the strongest positive association with firearm assault, and increased attitudes favoring retaliation also corresponded to higher firearm assault prevalence. Prosocial attitudes were protective for firearm assault risk, while resiliency was unassociated with firearm assault. Risky drug use, and mental health symptoms (PTSD, depression, anxiety) were associated with firearm assault; risky alcohol use was not associated with firearm assault. Having kept a firearm in one's car/house in the past six months, and past-six-month firearm carrying were both associated with firearm assault.

Table 3 shows a logistic regression model of firearm assault, adjusted for age, gender, and site. We included variables showing significance associations in Table 2; negative peer

behaviors were excluded due to evidence of multicollinearity with several other predictors. Similarly, family conflict and ACEs showed substantial content overlap, as did PTSD/depression/anxiety and firearm carrying frequency/keeping firearms in ones car/household; in each case we selected the variable with the largest unadjusted effect size. Community crime/violence showed the largest effect size, with a 1-point increase corresponding to a 13.7 % increase in the prevalence of self-reported firearm assault. The strongest protective effect was prosocial attitudes; each additional point on that scale corresponded to 1.6 % lower prevalence of self-reported firearm assault. Though some factors (e.g., positive peer behaviors) showed non-statistically significant effects, the direction of all effects agreed with unadjusted effects. The AUROC for the fitted model was 0.86, suggesting reasonable discriminatory power; the Hosmer-Lemeshow test, using the typical approach of decile splits, suggested no severe lack-of-fit ($p = 0.86$).

4. Discussion

We used data from a comprehensive baseline survey to describe violence rates, and other service needs (e.g., substance use, mental health) among a general population of young adults entering EDs in three cities, and examined factors associated with firearm assault. These results update previous ED-based studies of violence epidemiology against a backdrop of increasing national rates of violent injury, particularly firearm violence. Half of surveyed young adults presenting to urban EDs reported recent violence experience, and over one-seventh report recent firearm assault. Risky substance use and mental health symptoms were also commonly reported, across sites, underscoring a general ED sample of young adults as a high-need population. These findings point to the ongoing injury prevention opportunity in urban EDs; there are effective ED-based violence prevention programs (Carter et al., 2022; Carter et al., 2016) and these efforts may be informed by these contemporary results.

Previously published work from Project SPARK showed strong cross-sectional associations between the SaFETy score and self-reported firearm violence (Goldstick et al., 2024), and the results presented here suggest there are other important factors associated with firearm assault experience. Several factors not included in the original SaFETy score (Goldstick et al., 2017)—such as peer/parental support, family conflict and ACEs, retaliatory and prosocial attitudes, and mental health symptoms—showed strong associations with firearm assault in this sample. As standalone results, these associations point to the importance of social exposures and attitudes/norms in modulating firearm assault, which can inform interventions. In addition, they point to high-need subpopulations, such as those with more ACEs, greater family conflict, and drug use/mental health comorbidities.

While prior studies measuring firearm violence and a large set of sociodemographic factors are limited, these results do affirm prior results. In particular, associations between firearm violence and retaliatory attitudes, PTSD, firearm carriage, and drug use are consistent with prior work (Carter et al., 2015). Given the previously discussed national increases in firearm violence rates, particularly among children and young adults, results confirming similarities to dynamics observed in a sample from a decade earlier (Carter et al., 2015) provide important updates to the literature. At the same time, we presented associations not shown in

previous ED-based studies of firearm violence, such as those between self-reported firearm assault and family conflict, parental support, positive peer behaviors, and prosocial attitudes. Taken together, these results provide important contemporary context for future ED-based studies of firearm violence.

Replication of the previous machine-learning-based longitudinal analyses that derived the score in a general sample of young adults entering the ED, as opposed to the higher-risk sample in which the score was derived, and with a broader set of self-reported measures, is a critical next step for Project SPARK. Our baseline results confirm the importance of those next steps, and suggest optimism for their success. In particular, the high rates of violence—including firearm assault experience—show that general ED samples of young adults continue to be a population at elevated risk for violence. Thus, prospective ascertainment risk is critically important, particularly among those not presenting for reasons that suggest elevated violence risk (i.e., violent injury). This critical need is underscored by the fact that the SaFETy score is being measured in clinical sites already (Goyal et al., 2024), even without existing external validation. As described above, the strong associations identified here suggest, in combination with previously reported associations between the SaFETy score and self-reported firearm violence (Goldstick et al., 2024), there may be room for improved violence prediction. The forthcoming prospective validation will attempt to fill this critical gap.

Outside of firearm violence, our results point to other significant service needs of young adults entering the ED in all three cities. Sizable proportions reported severe violence involvement (both aggression and victimization), and about 1-in-10 report recent firearm carriage; this combination points to potential escalation of violence severity and critical opportunities for firearm safety counseling, particularly given previous research showing that firearm violence is often preceded by lower-level violence (Goldstick et al., 2019b). High rates of substance use and positive screen for PTSD, depression, and anxiety were also observed; these rates are substantially higher than corresponding rates in the general population. For example, 38.2 % of those age 18–25 reported past-year cannabis use in 2022 (Substance Abuse and Mental Health Services Administration (SAMHSA), 2024); we found nearly half of the sample reporting risky use—a higher threshold than any past-year use. Similarly, prevalence of PTSD among young adults is under 5 % (National Institute of Mental Health (NIMH), 2024), but nearly one-third of this sample screened positive ($PCL \geq 30$) for possible PTSD, suggesting substantially higher rates. The fact that these other services needs are all strongly associated with violence involvement in this sample further points to important prevention priorities among a general ED sample of young adults.

We acknowledge some limitations of this work. Importantly, all of the data presented here are self-reported, uncorroborated by objective sources. Our study did include an NIH certificate of confidentiality, but there is a possibility of misreporting, particularly with regard to higher risk behaviors. Second, relatedly, participants had the option of skipping questions. We felt this was an important human subjects protection, given the sensitive nature of some questions, but does raise the possibility of underreporting on the highest risk behaviors (e.g., ~1.7% missing on the firearm assault outcome, which may be a higher-risk subset). Third, individuals refusing study participation prior to receiving the baseline survey

were more likely to be men than those who did complete the baseline survey, raising minor concerns about selection bias. Fourth, the wording of the question related to firearms in ones household/car does not preclude that the firearm was owned and primarily handled by another household member; nevertheless we feel this question serves as an important proxy for firearm access in ones' home/car. Finally, the cross-sectional nature of this analysis undermines arguments about predictive power and whether the covariates preceded the outcomes. Nevertheless, these results comport with a priori expectations (e.g., showing strong convergent validity), and are an important next step in understanding the worsening problem of firearm violence in the US. Longitudinal results from Project SPARK will be critical to validating these results.

Violence—including severe violence, firearm violence, partner violence, and non-partner violence—is common among a general ED sample of young adults, and those with elevated violence risk also have other service needs. In addition, familial, peer, and community factors play strong roles in determining firearm assault risk. Taken together, this suggests it is possible to characterize those at highest risk, and leverage that information to inform intervention development, and efficiently disseminate resources.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data availability

As required by the funder, these data will be made available (deidentified) after the study is over and the primary aims are completed.

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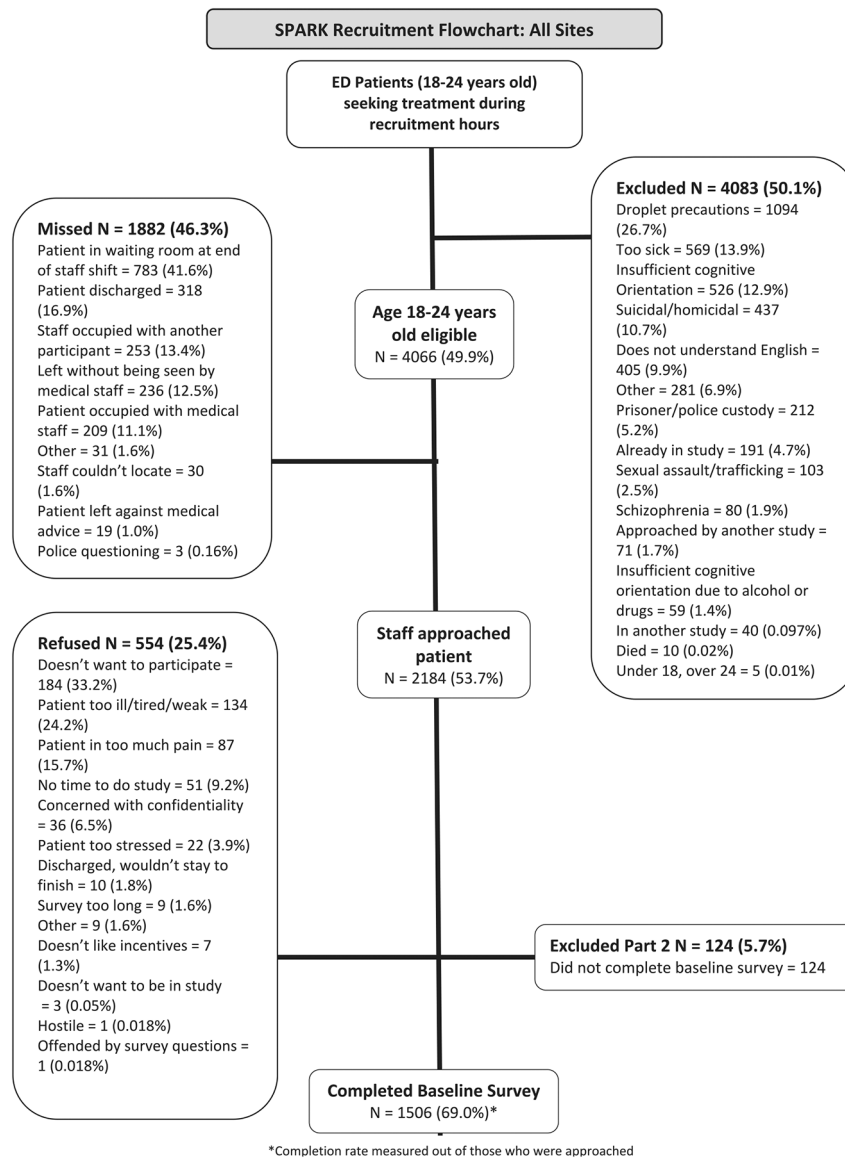


Fig. 1.
 Recruitment flow chart for the Screening to Predict Young Adults at Risk for Firearm Violence (SPARK) study, July 2021 – May 2023.

Table 1

Demographics, substance use, mental health symptoms, violence rates, and firearm-related behaviors among the sample at each site, and combined, July 2021 – May 2023.

	Total^a (N = 1506)	Seattle, WA (N = 649)	Flint, MI (N = 318)	Philadelphia, PA (N = 539)
<u><i>Demographics</i></u>				
Age [mean(SD)]	21.3 (1.9)	21.6 (1.9)	20.7 (2.0)	21.3 (1.9)
Gender				
Female n(%)	923 (61.4)	318 (49.1)	229 (72.0)	376 (69.9)
Male n(%)	540 (35.9)	305 (47.1)	84 (26.4)	151 (28.1)
Non-conforming n (%)	41 (2.7)	25 (3.9)	5 (1.6)	11 (2.0)
Race				
Black or African American n(%)	616 (41.7)	118 (18.7)	174 (55.1)	324 (61.0)
White n(%)	497 (33.6)	271 (43.0)	119 (37.7)	107 (20.2)
Asian n(%)	106 (7.2)	68 (10.8)	1 (0.3)	37 (7.0)
Other n(%)	113 (7.7)	78 (12.4)	7 (2.2)	28 (5.3)
Multiracial n(%)	145 (9.8)	95 (15.1)	15 (4.7)	35 (6.6)
In school n(%)	493 (33.1)	201 (31.2)	77 (24.4)	215 (40.5)
<u><i>Past-six-month substance use</i></u>				
Cannabis - risky use n(%)	708 (47.2)	323 (49.8)	166 (52.7)	219 (40.7)
Alcohol - risky use n (%)	481 (32.2)	244 (37.8)	70 (22.3)	167 (31.2)
Other illicit drug - risky use n(%)	105 (7.0)	80 (12.3)	10 (3.2)	15 (2.8)
Non-medical prescription drug - risky use n(%)	61 (4.1)	36 (5.6)	11 (3.5)	14 (2.6)
<u><i>Past-six-month violence</i></u>				
Any violence experience n(%)	740 (50.0)	345 (53.8)	157 (49.8)	238 (45.4)
Any partner violence n(%)	382 (25.7)	169 (26.1)	84 (26.8)	129 (24.4)
Any partner aggression n(%)	258 (17.3)	102 (15.7)	60 (19.1)	96 (18.1)
Any partner victimization n(%)	300 (20.1)	139 (21.5)	70 (22.3)	91 (17.1)
Any non-partner violence n(%)	631 (42.5)	303 (47.3)	128 (40.8)	200 (37.9)
Any non-partner aggression n(%)	405 (27.3)	175 (27.3)	93 (29.6)	137 (26.0)
Any non-partner victimization n(%)	556 (37.4)	278 (43.2)	110 (35.0)	168 (31.7)
Any ED visit for violent injury n(%)	150 (10.2)	69 (10.8)	34 (11.1)	47 (9.0)
<u><i>Firearms in car/household & firearm carrying</i></u>				
Kept firearm in car/household (lifetime) n(%)	292 (19.5)	144 (22.4)	69 (21.7)	79 (14.7)
Kept firearm in car/household (past 6-month) n(%)	170 (11.3)	79 (12.2)	44 (13.9)	47 (8.8)
Past 6-month carriage frequency [mean(SD)]	0.4 (1.3)	0.4 (1.3)	0.4 (1.4)	0.3 (1.2)
Any past 6-month carriage n(%)	157 (10.5)	83 (12.8)	34 (10.7)	40 (7.5)
<u><i>Mental health symptoms</i></u>				
Past month PTSD n (%)	430 (29.6)	210 (33.5)	97 (32.0)	123 (23.6)
Past-two-week depression n(%)	512 (34.7)	246 (38.8)	110 (35.0)	156 (29.6)
Past-two-week anxiety n(%)	513 (34.7)	235 (36.9)	123 (38.8)	155 (29.5)

	Total ^a (N = 1506)	Seattle, WA (N = 649)	Flint, MI (N = 318)	Philadelphia, PA (N = 539)
Past-two-week suicidal ideation n (%)	56 (3.8)	34 (5.4)	9 (2.8)	13 (2.5)

Note: Risky substance use variables indicate a score of ≥ 4 on the National Institute on Drug Abuse modified Alcohol, Smoking, and Substance Use Involvement Screening Test (ASSIST) for Cannabis, at least one illicit drug (cocaine, street opioids, methamphetamine, inhalants, hallucinogens), and at least one prescription drug (sedatives, opioids, stimulants) used non-medically in the “Cannabis”, “Other illicit drug”, and “Non-medical prescription drug” rows, respectively.

Note 2: The risky alcohol use indicator was calculated using the three-item Alcohol Use Disorder Identification Test (AUDIT-C), with a cut point of ≥ 4 for men, and ≥ 3 for women.

PTSD: Post-traumatic stress disorder; SD: Standard deviation.

^aThe denominator for cell percentages may not equal the column total due to missing data. Among variables with any missing data, the number missing ranged from 2 (0.1 %: other illicit misuse; gender) to 55 (3.7 %: PTSD).

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Table 2

Sociodemographic, substance use, and mental health characteristics of study participants, and contrasts between those who did versus did not self-report firearm assault (including threats) (Seattle, Flint, and Philadelphia; July 2021 – May 2023).

	Total with firearm Outcome ^a (N = 1481)	Firearm assault (N = 214)	No firearm assault N = 1267)	Cohen's effect size ^b (95 % CI)
<i>Demographics</i>				
Age [mean(SD)] (range: 18–24)	21.3 (1.9)	21.4 (1.9)	21.3 (2.0)	0.05 (–0.10, 0.19)
Male gender n(%)	528 (35.7)	99 (46.3)	429 (33.9)	0.25 (0.11, 0.40)
<i>Peer behaviors</i>				
Positive behaviors [mean (SD)] (range: 0–4) ^c	1.6 (0.9)	1.4 (0.9)	1.6 (0.8)	–0.27 (–0.42, –0.12)
Negative behaviors [mean (SD)] (range: 0–4) ^c	0.7 (0.6)	1.1 (0.7)	0.7 (0.6)	0.67 (0.50, 0.84)
Peer support [mean(SD)] (range: 1–5) ^c	3.2 (1.1)	3.0 (1.1)	3.3 (1.1)	–0.20 (–0.35, –0.06)
<i>Familial/parental</i>				
Parental support [mean(SD)] (range: 1–5) ^d	3.3 (1.2)	2.7 (1.2)	3.4 (1.2)	–0.56 (–0.72, –0.41)
Family conflict [mean(SD)] (range: 1–4) ^c	1.7 (0.7)	2.2 (0.9)	1.6 (0.7)	0.76 (0.58, 0.93)
ACEs [mean(SD)] (range: 0–8) ^e	2.6 (2.1)	3.8 (2.2)	2.4 (2.1)	0.65 (0.49, 0.81)
<i>Community & Attitudes</i>				
Community violence [mean (SD)] (range: 0–3) ^f	0.6 (0.7)	1.4 (0.8)	0.5 (0.6)	1.23 (1.03, 1.42)
Retaliatory attitudes [mean (SD)] (range: 1–4) ^g	2.4 (0.5)	2.6 (0.5)	2.3 (0.5)	0.55 (0.40, 0.71)
Resiliency [mean (SD)] (range: 1–5) ^h	3.7 (0.8)	3.7 (0.8)	3.8 (0.7)	–0.03 (–0.19, 0.12)
Prosocial attitudes [mean (SD)] (range: 1–5) ⁱ	3.8 (0.9)	3.7 (1.0)	3.8 (0.9)	–0.18 (–0.33, –0.02)
<i>Past-six-month firearm behaviors</i>				
Firearms in car/household n(%) ^j	169 (11.4)	51 (24.2)	118 (9.3)	0.41 (0.26, 0.66)
Firearm carriage frequency [mean (SD)] (range:0–6) ^j	0.4 (1.3)	1.2 (2.1)	0.3 (1.1)	0.54 (0.36, 0.72)
<i>Substance use/mental health</i>				
Past-six-month risky alcohol use n(%) ^k	476 (32.3)	72 (34.0)	404 (32.0)	0.04 (–0.10, 0.19)
Past-six-month any risky drug use n(%) ^l	726 (49.2)	158 (74.5)	568 (44.9)	0.61 (0.47, 0.76)
Past-month PTSD n(%) ^m	427 (29.8)	118 (59.0)	309 (25.0)	0.70 (0.55, 0.85)
Past-two-week depression n(%) ⁿ	508 (34.9)	113 (54.6)	395 (31.7)	0.47 (0.32, 0.61)
Past-two-week anxiety n(%) ^o	509 (34.9)	115 (55.0)	394 (31.4)	0.48 (0.33, 0.63)

PTSD: Post-traumatic stress disorder; ACEs: Adverse childhood experiences; SD: Standard deviation.

^a : The denominator for cell percentages may not equal the column total due to missing data. The number missing in the rows ranged from 1 (0.1 %: gender) to 47 (3.2 %: PTSD); there was no missing data for age.

^b : This quantifies the difference between those self-reporting firearm assault, minus those not self-reporting firearm assault. For numeric variables (e.g., age), the value in the table is the Cohen's d (using the unpooled SD, thus not assuming equal variances). For binary variables (e.g., positive PTSD Screen), the value in the table is the Cohen's h.

c: Measured using a summary score based on items from the Flint Adolescent Study (Zimmerman et al., 2002).

d: Measured using a summary score based on items from Procidano and Heller's social support scale (Procidano and Heller, 1983).

e: Measured as the number of ACEs reported using items from the National Survey of Child Health (The Child and Adolescent Health Measurement Initiative (CAHMI), 2024).

f: Measured using a summary score based on items from the "Things I've Seen and Heard" survey (Richters and Saltzman, 1990).

g: Measured using a summary score based on items from Hill and Noblin (Hill and Noblin, 1991).

h: Measured using a summary score based on items from the Brief Resilient Coping Scale (Sinclair and Wallston, 2004).

i: Measured using a summary score based on items from the Prosociality scale of Caprara et al (Caprara et al., 2005).

j: Measured using items modified from the Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention (CDC), 2021).

k: Measured using the three-item Alcohol Use Disorders Identification Test summary score, with a cutpoint of 4 for men, and 3 for women (Chung et al., 2000).

l: Measured using summary scores from the National Institute on Drug Abuse modified Alcohol, Smoking and Substance Involvement Screening Test (National Institute on Drug Abuse (NIDA), 2024). The indicator is calculated as a score of 4 or more on any of: cannabis, cocaine, street opioids, methamphetamine, inhalants, hallucinogens, non-medical use of prescription sedatives, non-medical use of prescription opioids, and non-medical use of prescription stimulants).

m: Measured using a summary score from the PTSD checklist-17 (PCL-17) (Lang and Stein, 2005) with the indicator calculated based on a total score of 30 or higher.

n: Measured using a summary score from the Patient Health Questionnaire-9 (PHQ-9) (Richardson et al., 2010) with the indicator calculated based on a total score of 10 or higher.

o: Measured using a summary score from the Generalized Anxiety Disorder-(GAD-7) (Spitzer et al., 2006) with the indicator calculated based on a total score of 10 or higher.

Table 3

Adjusted differences in prevalence of self-reported firearm assault in the sample, calculated using logistic regression with effects displayed as marginal effects. Respondents were age 18–24, and data were collected in Seattle, Flint, and Philadelphia; July 2021 – May 2023.

	Adjusted prevalence difference (95 % CI)
<i>Demographics</i>	
Age (range: 18–24)	0.3 (–0.6, 1.1)
Gender	
Female/non-conforming	(ref)
Male	2.3 (–1.3, 5.9)
<i>Site</i>	
Seattle, Washington	(ref)
Flint, Michigan	–3.5 (–7.6, 0.7)
Philadelphia, Pennsylvania	–4.2 (–7.9, –0.5)
<i>Peer & familial/parental</i>	
Peer positive behaviors (range: 0–4)	–1.0 (–2.8, 0.8)
Parental support (range: 1–5)	–1.0 (–2.3, 0.3)
Family conflict (range: 1–4)	3.8 (1.3, 6.3)
<i>Community & Attitudes</i>	
Retaliatory attitudes (range: 1–4)	4.9 (0.3, 9.5)
Prosocial attitudes (range: 1–5)	–1.6 (–3.1, –0.0)
Community violence (range: 0–3)	13.7 (10.4, 16.9)
<i>Firearm behaviors</i>	
Firearm carriage frequency (range: 0–6)	1.4 (0.3, 2.4)
<i>Past-two-week post-traumatic stress disorder</i>	
No	(ref)
Yes	5.1 (1.1, 8.9)
<i>Past-six-month risky drug use</i>	
No	(ref)
Yes	4.2 (0.9, 7.6)

Note: This model was fit to complete cases; i.e., individuals with non-missing values for both the outcome and all of the covariates in the model ($n = 1312$).

Note 2: The effects displayed in the table are calculated from logistic regression with covariate effects displayed as marginal effects rather than odds ratios; these are interpreted directly as adjusted prevalence differences corresponding to a 1-unit increase for numeric predictors, and as adjusted contrasts of prevalence for different categories on the nominal predictors.