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The Burden of Child and Adolescent Firearm Homicide

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Abstract

Firearm homicide is a leading cause of death among children and adolescents. This study examined variability in the correlates of firearm homicide across child and adolescent firearm homicide victims. U.S. firearm homicide victims comprising three developmental groups were identified in the National Violent Death Reporting System (2003–2021): infant and early child victims aged 0–5 years (N = 3992); middle and late child victims aged 6–12 years (N = 996); and adolescent victims aged 13–19 years (N = 8350). Descriptive statistics and multivariate regression analysis demonstrated strong support for the study hypotheses. First, firearm homicide victimization peaked among young children (0–5) and adolescents (13–19). Second, older victims were disproportionately male and overwhelmingly had male perpetrators. Third, younger victims were more likely to be killed by their caregivers, family members, and in the home. Finally, situational characteristics were more relevant for adolescent victims. The results suggest that the correlates of child and adolescent firearm homicide are developmentally patterned and reflect age-graded differences in familial reliance, autonomy, and social involvement.

Keywords: firearm; homicide; victimization; child; adolescent

1. Introduction

Firearm homicide is one of the most serious threats to child and adolescent health in the United States. In 2023, there were 17,927 firearm homicides, representing almost 40% of all firearm-related deaths (e.g., homicides, suicides, fatal unintentional discharges) and more than 75% of all homicides in the U.S. [1]. Of these firearm homicides, more than 15% (2947/17,927) were of children and adolescents aged 0–19 years. Indeed, firearms were the leading cause of child and adolescent death in 2023, and homicide was among the top four leading causes of death for both children and adolescents [1].

While firearm homicide is not unique to the U.S., American youth are significantly more likely than youth in other socioeconomically developed and industrialized countries to die by firearm homicide [2]. Estimates from 2010 World Health Organization mortality data indicate that firearm homicide rates among U.S. infants and children aged 0–4 years, children and early adolescents aged 5–14 years, and adolescents and young adults aged 15–24 years, were 22.3, 18.5, and 49.0 times higher, respectively, than the aggregate firearm homicide rates in 22 high-income non-U.S. countries [3]. Given the disproportionate concentration of firearm homicide among U.S. youth and increasing rates of life expectancy over the last century [4], Americans now lose more than one million years of their lives to firearm homicide in any given year [5].

Beyond loss of life, firearm violence has wide-reaching impact. In 2023, 27,802 youth aged 10–19 were treated in emergency departments for nonfatal gunshot injuries, many

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resulting in permanent life changes and disabilities [1]. Victims' family members, friends, and broader communities suffer psychological effects such as depression, anxiety, anger, and guilt; and socio-behavioral effects of exposure to firearm violence include school- and work-related problems, suicidal ideation, and aggression [6]. There is also significant financial burden for survivors, employers, and taxpayers, including: funeral costs and medical bills; investments in the criminal justice system; lost wages and productivity; devaluation of property; and other quality of life losses [7,8]. The Centers for Disease Control and Prevention (CDC) [1] estimate that the economic cost of homicide, including medical costs and value of statistical life, exceeded $270 billion in 2023.

Yet, firearm homicide does not impact U.S. residents uniformly. Relevant to this study, research suggests that there are meaningful differences across age among child and adolescent firearm homicide victims [9]. However, with notable exceptions [10], studies examining differences in the correlates of firearm homicide across child and adolescent victims are sparse. Accordingly, this study compares the victim, offender, situational, and contextual characteristics of firearm homicide victimization across three early-life developmental groups: infant and early child firearm homicide victims aged 0–5 years; middle and late child victims aged 6–12 years; and adolescent victims aged 13–19 years.

These developmental stages early in the life course are well-established in the pediatric, youth development, and child psychology literature [11,12]. Further, research examining patterns in homicide across age, sex, and victim–offender relationship has demonstrated a clear delineation between infants, toddlers, and young children (0–5), older children (6–12), and teens (13–19) [13,14]. Indeed, extant research indicates that homicide risk varies across early life stages, with a higher risk of homicide victimization in early childhood and late adolescence than during middle and late childhood [13,15]. Research also suggests that there are meaningful differences in the correlates of firearm homicide across infant and early child victims, middle and late child victims, and adolescent victims [10,14]. Developmental and life course criminology provide a lens to understand these differences.

The life course perspective is a broad paradigm that considers continuity and change in patterns of offending across developmental life stages [16,17]. Applied to victimization, this perspective recognizes that the risk of being victimized across the life course is influenced by an array of risk and protective factors, including cognitive capabilities (e.g., self-reliance, identity transformation, and decision-making), ties to different social institutions (e.g., marriage and employment), lifestyle patterns, and the macro-social context [18]. As such, patterns in firearm homicide risk across the life course could reflect developmental differences in autonomy and social involvement. For example, infants and young children are highly (or exclusively) reliant on parents and caregivers, unable to avoid interpersonal conflict in the home environment or to report personal abuse and neglect [19]. On the other hand, independence from the family unit and the growing role of friendship networks during adolescence increase the potential for victimization by teachers, peers, and other non-family persons [20]. Additionally, romantic relationships, risky behaviors such as alcohol and substance use, and peer pressure to engage in antisocial conduct increase during late childhood and adolescence as normative and biologically driven parts of development [21], yet also increase the risk for victimization.

While very young children and adolescents are quite vulnerable to homicide victimization, in part for the reasons aforementioned, older children (6–12) have protective factors in place. In particular, they are gaining independence and spending time away from home (primarily in school) but not yet engaging in the risky behaviors that are normative during adolescence. These factors may help them circumvent conflict in the home, communicate with non-familial adults about household danger, and elude some of the situational influences of homicide [13]. As Maltz states [22], older children are "relatively safe from

homicides, too old to be killed by their 'caregivers' yet too young to be killed by their peers" (p. 37).

Grounded in these insights from prior research and the life course perspective, I expect to observe a bimodal distribution of firearm homicide victimization with peaks in early childhood and late adolescence (Hypothesis 1). I also posit that adolescent victims of firearm homicide (Hypothesis 2)—and their perpetrators (Hypothesis 3)—will be disproportionately male, relative to their younger counterparts. While men commit roughly 90% of all homicides worldwide, and approximately 80% of homicide victims are male [23], the gender distributions of younger homicide victims and perpetrators are more equitable, as intrafamilial homicide tends to be perpetrated by both male and female household members [14]. Moreover, females are disproportionately affected by homicidal violence in the home by family members and intimate partners [23].

Given children's reliance on parents and caregivers, as well as the amount of time spent in the home, I also expect younger victims of homicide to be disproportionately killed by their caregivers (Hypothesis 4), by family members (Hypothesis 5), and in the home (Hypothesis 6), relative to adolescent victims of firearm homicide. Further, given that adolescence is a time of exploration outside of the home, I expect situational characteristics relevant to firearm homicide, in particular gang involvement, drug dealing and usage, and incidents related to previous arguments or criminal activity, to be disproportionately common among adolescent firearm homicide victims (Hypothesis 7). To investigate these hypotheses, this study uses descriptive analysis and multilevel regression models on data from the National Violent Death Reporting System (NVDRS), currently the most comprehensive and detailed data source on homicide in the U.S.

2. Materials and Methods

2.1. Data

The NVDRS is a state-based web surveillance system of all persons in the U.S. who die by homicide, unintentional firearm fatality, legal intervention, suicide, and undetermined intent. Established in 2003 by the CDC, the NVDRS initially included data from seven states before becoming nationally representative in 2020 (see Appendix A). The NVDRS integrates data from death certificates, coroner and medical examiner records, law enforcement reports, crime lab and toxicology reports, hospital discharge data, court records, Child Fatality Review reports, Bureau of Alcohol, Tobacco, Firearms and Explosives firearms trace data, Supplementary Homicide Reports, and National Incident-Based Reporting System records. Data collection and abstraction are conducted by each state, but the CDC protects against systematic data errors by using automated software validation during data entry, ensuring interrater reliability, producing annual quality assurance reports, and providing coding support.

The study sample consists of all 13,338 firearm homicide victims in the NVDRS aged 0–19 years from 2003 to 2021. The NVDRS defines homicide as death resulting from the intentional use of threatened or actual force or power against another person, group, or community (ICD-10 codes X85-X99, U01-U03, Y00-Y09, and Y87.1). Homicide includes: incidents with intent to injure; deaths induced by threat of force (e.g., heart attack); self-defense or "justifiable homicides" (not by a law enforcement officer); and intentional abuse or neglect. Non-firearm homicides and those in which the cause of death was undetermined or accidental were excluded.

2.2. Measures

Four types of variables are examined in this study: victim variables, offender variables, situational characteristics, and contextual factors. This study only considers vari-

ables relevant to all of the developmental groups (e.g., employment and marital status were excluded).

Victim variables include biological sex (0 = male, 1 = female) and race and ethnicity (Hispanic, non-Hispanic African American, non-Hispanic White, and "other"). A binary (0 = no, 1 = yes) measure assessed whether the homicide victim had been the victim of another incidence of interpersonal violence within the month preceding the homicide.

Offender variables include biological sex and race and ethnicity. Two additional binary variables assessed whether the homicide perpetrator had a history of abusing the victim or served as the victim's caregiver.

Situational characteristics include the victim–offender relationship—family member; friend, acquaintance, or intimate partner; other known person; and stranger—and the location of the homicide—inside a private residence, or outside of a home or apartment (i.e., on the street, in a parking lot, in a vehicle, or in a restaurant). A series of binary variables captured whether the incident was the product of intimate partner violence; followed an argument or physical fight; was related to gang warfare; was precipitated by victim weapon use; occurred during another crime; or was related to drug dealing, trading, or usage. Two additional binary variables assessed whether the victim had alcohol in their system at time of death, or had amphetamines, opiates, marijuana, or cocaine in their system at death.

The 13,338 homicide victims in the study resided in 2929 census places, which were identified by Federal Information Processing Standard (FIPS) 55-3 codes and included: cities; counties; county subdivisions; American Indian and Alaskan Native areas; several kinds of facilities (e.g., national parks, military installations, and major airports); and statistically equivalent legal and statistical entities as recognized by the U.S. Census Bureau. Place-level data for the study midpoint (2009–2013) were derived from the U.S. Census Bureau's American Community Survey and appended to homicide victims in the NVDRS using geographic identifiers. Concentrated disadvantage is the weighted factor score of six indicators: percentage of the population aged 18–64 living below the poverty line; percentage of the civilian workforce unemployed; percentage of single-female-headed household with children; percentage of the population aged 25 and older with a high school degree; percentage of the population aged 15 and older who were married; and median household income (last three items reverse coded). Racial and ethnic heterogeneity was measured using Blau's index—the sum of the squared proportion of the population in each racial and ethnic group subtracted from 1. Residential stability is the average of the proportion of the population living in owner-occupied housing and the proportion of residents living in the same house for the past year [24].

2.3. Statistical Analysis

The analysis proceeded in two stages. First, descriptive analysis compared the correlates of firearm homicide victimization across the age-defined groups. Chi-square tests and *t*-tests compared each group pair. Second, multivariate regression models provided a more rigorous examination of differences in the correlates of firearm homicide across developmental groups. In particular, three logistic regression models accounting for the clustering of victims within places via Stata's vce (cluster) option allowed for the simultaneous control of all study variables and systematically examined age differences without artificial clustering. In the first regression model, middle and late child victims were coded "1" for the outcome variable, and infant and early child victims were coded "0" and served as the reference group. In the second and third models, adolescent victims were coded in the affirmative and infant and early child victims, and middle and late child victims, respectively, served as reference groups.

3. Results

3.1. Descriptive Analysis

Table 1 presents descriptive statistics for the victim, offender, situational, and contextual characteristics across infant and early child firearm homicide victims aged 0–5 years, child victims aged 6–12 years, and adolescent victims aged 13–19 years. Consistent with Hypothesis 1, there was a bimodal distribution of firearm homicide victimization in the study sample, with peaks among infant and early child victims aged 0–5 years (N = 3992) and adolescent victims aged 13–19 years (N = 8350). Comparatively, there were 996 middle and late child victims aged 6–12 years.

Table 1. Descriptive Statistics for Firearm Homicide Victims Age 0–19 across 50 U.S. States and the District of Columbia, 2003 to 2021 (N = 13,338 Victims).

	Infant and Early Child Victims, Age 0–5 (N = 3992)		**Middle and Late Child Victims, Age 6–12 (N = 996)**		**Adolescent Victims, Age 13–19 (N = 8350)**	
Variable	**N (%) or Mean (SD) [Range]**					
Victim Variables						
Sex [bc]						
Male	2266	(56.76)	538	(54.02)	6810	(81.56)
Female	1726	(43.24)	458	(45.98)	1540	(18.44)
Race and Ethnicity [bc]						
White	1545	(38.70)	395	(39.67)	1549	(18.55)
African American	1529	(38.30)	371	(37.23)	5139	(61.55)
Hispanic	598	(14.99)	144	(14.44)	1315	(15.75)
Other	320	(8.01)	86	(8.66)	347	(4.15)
Had Recent History of Victimization [abc]	355	(8.88)	39	(3.88)	103	(1.24)
Offender Variables						
Sex [abc]						
Male	2373	(59.44)	719	(72.21)	7740	(92.69)
Female	1619	(40.56)	277	(27.79)	610	(7.31)
Race and Ethnicity [bc]						
White	1570	(39.32)	401	(40.29)	1612	(19.30)
African American	1684	(42.18)	385	(38.66)	5186	(62.11)
Hispanic	504	(12.61)	140	(14.03)	1191	(14.27)
Other	234	(5.89)	70	(7.02)	361	(4.32)
Had History of Abusing Victim [abc]	895	(22.42)	110	(11.01)	199	(2.38)
Was Victim's Caregiver [abc]	2802	(70.19)	459	(46.12)	312	(3.73)
Situational Characteristics						
Victim–Offender Relationship [abc]						
Family	2722	(68.19)	646	(64.80)	971	(11.63)
Friend, Acquaintance, or Intimate Partner	177	(4.44)	113	(11.38)	3382	(40.50)
Other Known Person	1025	(25.67)	170	(17.10)	2508	(30.04)
Stranger	68	(1.70)	67	(6.72)	1489	(17.83)
Incident Location [abc]						
Inside Home or Apartment	3536	(88.58)	828	(83.11)	3384	(40.53)

Table 1. *Cont.*

	Infant and Early Child Victims, Age 0–5 (*N* = 3992)		Middle and Late Child Victims, Age 6–12 (*N* = 996)		Adolescent Victims, Age 13–19 (*N* = 8350)	
Variable	***N* (%) or Mean (SD) [Range]**					
Outside Home or Apartment	311	(7.80)	119	(11.94)	4211	(50.43)
Other	145	(3.62)	49	(4.95)	755	(9.04)
Related to Intimate Partner Violence [abc]	290	(7.27)	193	(19.37)	799	(9.57)
Followed Argument or Fight [abc]	917	(22.96)	199	(19.98)	3152	(37.74)
Related to Gang Involvement [abc]	36	(0.89)	39	(3.96)	1339	(16.03)
Precipitated by Victim Weapon Use [bc]	13	(0.33)	5	(0.51)	732	(8.76)
Occurred During another Crime [abc]	625	(15.67)	270	(27.13)	2833	(33.92)
Related to Drug Dealing or Usage [bc]	121	(3.03)	44	(4.41)	1371	(16.42)
Victim Had Alcohol in System at Death [abc]	276	(6.92)	107	(10.72)	1741	(20.85)
Victim Had Drugs in System at Death [bc]	783	(19.61)	197	(18.76)	4164	(49.87)
Place Characteristics						
Concentrated Disadvantage [abc]	−0.24 (0.78) [−3.32–2.70]		−0.14 (0.86) [−2.55–3.67]		−0.43 (0.76) [−2.90–3.52]	
Residential Stability [abc]	68.33 (8.24) [26.51–100]		69.36 (8.55) [44.34–96.12]		66.59 (7.46) [23.70–100]	
Racial and Ethnic Heterogeneity [bc]	0.48 (0.18) [0–0.76]		0.48 (0.18) [0–0.76]		0.54 (0.14) [0–0.77]	

Abbreviation: SD = standard deviation

Notes: Superscripts on variable names represent significant differences ($p < 0.05$) between victims aged 0–5 and victims aged 6–12 (a), victims aged 0–5 and victims aged 13–19 (b), and victims aged 6–12 and victims aged 13–19 (c). Significance tests were conducted via Chi-Square and *t*-tests.

Turning to differences in the correlates of firearm homicide victimization across developmental groups, superscripts on the variable names in Table 1 indicate significant differences ($p < 0.05$) across each developmental group pair. Regarding the victim variables, and consistent with Hypothesis 2, older victims were more likely to be male. In fact, 81.56% ($N = 6810$) of adolescent victims were male, whereas slightly more than half of infant and early child victims (56.76%, $N = 2266$) and middle and late child victims (54.02%, $N = 538$) were male. Also observe that similar percentages of infant and early child victims were White (38.70%, $N = 1545$) and African American (38.30%, $N = 1529$), and similar percentages of middle and late child victims were White (39.67%, $N = 395$) and African American (37.23%, $N = 371$). On the other hand, 18.55% ($N = 1549$) of adolescent victims were White, while 61.55% ($N = 5139$) were African American. Further, repeat victimization was more common among younger victims.

Similar patterns were observed for the offender variables. Consistent with Hypothesis 3, the offenders of more than nine in ten adolescent victims were male (92.69%, $N = 7740$), while 59.44% ($N = 2373$) of the offenders of infant and child victims and 72.21% ($N = 719$) of the offenders of middle and late child victims were male. Additionally, there were

less white and more African American offenders as victim age increased, and a history of abusing the victim was more common among offenders of younger victims. Consistent with Hypothesis 4, almost three-quarters of the offenders of infant and child victims (70.19%, $N = 2802$) were their caregivers, while just under one-half of the offenders of middle and late child victims (46.12%, $N = 459$) were their primary caregivers. In contrast, only 3.73% ($N = 312$) of the offenders of adolescent victims were their caregivers.

For the situational characteristics, and consistent with Hypothesis 5, younger victims were more likely to be killed by family members—68.19% ($N = 2722$) for infant and child victims, 64.80% ($N = 646$) for middle and late child victims, and 11.63% ($N = 971$) for adolescent victims—while older victims were more likely to be killed by friends, acquaintances, intimate partners, and strangers. Consistent with Hypothesis 6, younger victims were more likely to be killed in their homes. In fact, 88.58% ($N = 3536$) of infant and child victims and 83.11% ($N = 828$) of middle and late child victims, but only 40.53% ($N = 3384$) of adolescent victims, were killed in their homes. Further, consistent with Hypothesis 7, older victims were more likely to be killed in incidents that followed an argument or fight, were related to gang involvement, were precipitated by victim weapon use, occurred during another crime, or involved drug dealing or usage (including alcohol and drug use by the victim). For the place characteristics, older victims tended to be killed in places with lower levels of concentrated disadvantage and residential stability, and higher levels of racial and ethnic heterogeneity.

3.2. Multivariate Regression Models

Tables 2–4 present the three logistic regression models (accounting for the clustering of victims within places) that examined differences in the correlates of firearm homicide victimization across the three developmental groups. Table 2 compares the middle and late child victims—coded as "1" in the outcome variable—to the infant and early child victims—coded as "0" and serving as the reference group. Table 3 compares the adolescent victims to the infant and early child victims (reference group). Table 4 compares the adolescent victims to the middle and late child victims (reference group).

Confirming the preliminary findings from the descriptive analysis, and consistent with Hypothesis 2, the odds of being female were 44% lower among adolescent victims than among infant and child victims (OR = 0.56, 95% CI = 0.48, 0.66) and middle and late child victims (OR = 0.56, 95% CI = 0.45, 0.69). Similarly, and consistent with Hypothesis 3, the odds of the homicide offender being female were 68% lower among adolescent victims than among infant and child victims (OR = 0.32, 95% CI = 0.26, 0.39) and 35% lower among adolescent victims than among middle and late child victims (OR = 0.65, 95% CI = 0.30, 0.84). The differences between infant and early child victims and middle and late child victims did not reach significance. Consistent with Hypothesis 4, the odds of the homicide offender being the victim's caregiver were 48% lower among middle and late child victims than among infant and early child victims (OR = 0.52, 95% CI = 0.43, 0.62), 90% lower among adolescent victims than among infant and early child victims (OR = 0.10, 95% CI = 0.08, 0.12), and 75% lower among adolescent victims than among middle and late child victims (OR = 0.25, 95% CI = 0.19, 0.33). Also note that infant and child victims were significantly less likely than both middle and late child victims and adolescent victims to have had a recent history of victimization and abuse by the homicide perpetrator. Findings regarding race and ethnicity were inconsistent across the victim groups.

Table 2. Multivariate Regression Examining the Factors that Distinguish Middle and Late Child Victims Age 6–12 from Infant and Child Victims Age 0–5 (Reference), $N = 4988$ [a].

Variables	OR	95% CI
Victim Variables		
Female	1.06	[0.91, 1.23]
Race and Ethnicity [b]		
African American	1.02	[0.76, 1.37]
Hispanic	0.84	[0.60, 1.17]
Had Recent History of Victimization	0.62 *	[0.42, 0.92]
Offender Variables		
Female	1.02	[0.76, 1.37]
Race and Ethnicity [b]		
African American	0.74 *	[0.55, 0.99]
Hispanic	1.05	[0.73, 1.52]
Had History of Abusing Victim	0.75 *	[0.58, 0.98]
Was Victim's Caregiver	0.52 ***	[0.43, 0.62]
Situational Characteristics		
Victim–Offender Relationship [c]		
Friend, Acquaintance, or Intimate Partner	2.10 ***	[1.54, 2.84]
Stranger	2.28 ***	[1.45, 3.56]
Incident Location [d]		
Outside Home or Apartment	1.21	[0.93, 1.61]
Related to Intimate Partner Violence	2.37 ***	[1.82, 3.09]
Followed Argument or Fight	0.94	[0.71, 1.26]
Related to Gang Involvement	3.07 ***	[1.80, 5.24]
Precipitated by Victim Weapon Use	0.73	[0.16, 3.35]
Occurred During another Crime	1.63 ***	[1.28, 2.06]
Related to Drug Dealing or Usage	1.15	[0.71, 1.84]
Victim Had Alcohol in System at Death	1.23	[0.86, 1.76]
Victim Had Drugs in System at Death	0.76	[0.56, 1.02]
Place Characteristics		
Concentrated Disadvantage	1.22 **	[1.07, 1.39]
Residential Stability	1.01	[0.99, 1.02]
Racial and Ethnic Heterogeneity	1.53	[0.87, 2.68]

Abbreviation: OR = odds ratio; CI = confidence interval. [a] The models also include dummy variables representing year of death and "other" categories for race and ethnicity, victim–offender relationship, and incident location. [b] Reference = White; [c] Reference = Family; [d] Reference = Inside Home or Apartment. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ (two-tailed tests).

Regarding the situational characteristics, older victims were more likely to be killed by non-family members, consistent with Hypothesis 5. In particular, the odds that the homicide offender was the victim's friend, acquaintance, or intimate partner, relative to a family member, were 110% higher among middle and late child victims than among infant and early child victims (OR = 2.10, 95% CI = 1.54, 2.84); and the odds that the homicide offender was a stranger, relative to a family member, were 128% higher among middle and late child victims than among infant and early child victims (OR = 2.28, 95% CI = 1.45, 3.56). The results were even more striking when comparing child victims to adolescent victims. The odds that the homicide offender was the victim's friend, acquaintance, or intimate partner, relative to a family member, were 1273% higher among adolescent victims than among infant and early child victims (OR = 13.73, 95% CI = 10.69, 17.62); and the odds that the homicide offender was a stranger, relative to a family member, were 493% higher among adolescent victims than among infant and early child victims (OR = 5.93, 95% CI = 4.22, 8.33). Similarly, the odds that the homicide offender was the victim's friend, acquaintance, or intimate partner, relative to a family member, were 658% higher among adolescent victims than among middle and late child victims (OR = 7.58, 95% CI = 5.63,

10.20); and the odds that the homicide offender was a stranger, relative to a family member, were 219% higher among adolescent victims than among middle and late child victims (OR = 3.19, 95% CI = 2.18, 4.65).

Table 3. Multivariate Regression Examining the Factors that Distinguish Adolescent Victims Age 13–19 from Infant and Child Victims Age 0–5 (Reference), *N* = 12,342 [a].

Variables	OR	95% CI
Victim Variables		
Female	0.56 ***	[0.48, 0.66]
Race and Ethnicity [b]		
African American	1.45 **	[1.16, 1.81]
Hispanic	1.03	[0.79, 1.33]
Had Recent History of Victimization	0.42 ***	[0.29, 0.62]
Offender Variables		
Female	0.32 ***	[0.26, 0.39]
Race and Ethnicity [b]		
African American	0.81	[0.64, 1.02]
Hispanic	0.85	[0.62, 1.16]
Had History of Abusing Victim	0.73 *	[0.55, 0.97]
Was Victim's Caregiver	0.10 ***	[0.08, 0.12]
Situational Characteristics		
Victim–Offender Relationship [c]		
Friend, Acquaintance, or Intimate Partner	13.73 ***	[10.69, 17.62]
Stranger	5.93 ***	[4.22, 8.33]
Incident Location [d]		
Outside Home or Apartment	5.14 ***	[4.26, 6.20]
Related to Intimate Partner Violence	1.77 ***	[1.31, 2.40]
Followed Argument or Fight	2.05 ***	[1.70, 2.48]
Related to Gang Involvement	5.24 ***	[3.26, 8.43]
Precipitated by Victim Weapon Use	5.92 ***	[2.56, 13.73]
Occurred During another Crime	1.41 **	[1.14, 1.74]
Related to Drug Dealing or Usage	2.22 ***	[1.63, 3.03]
Victim Had Alcohol in System at Death	1.56 ***	[1.24, 1.97]
Victim Had Drugs in System at Death	1.85 ***	[1.49, 2.30]
Place Characteristics		
Concentrated Disadvantage	1.11	[0.98, 1.26]
Residential Stability	1.01	[0.99, 1.02]
Racial and Ethnic Heterogeneity	3.07 ***	[1.72, 5.49]

Abbreviation: OR = odds ratio; CI = confidence interval. [a] The models also include dummy variables representing year of death and "other" categories for race and ethnicity, victim–offender relationship, and incident location. [b] Reference = White; [c] Reference = Family; [d] Reference = Inside Home or Apartment. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ (two-tailed tests).

Consistent with Hypothesis 6, older victims were significantly less likely to be killed in their homes. The odds of the homicide occurring outside of the home were 414% and 275% higher among adolescent victims than among infant and child victims (OR = 5.14, 95% CI = 4.26, 6.20) and middle and late child victims (OR = 3.75, 95% CI = 2.94, 4.78), respectively. The difference between infant and early child victims and middle and late child victims did not reach significance.

Consistent with Hypothesis 7, older victims were significantly more likely to be killed in incidents that followed an argument or fight, were related to gang involvement, were precipitated by victim weapon use, occurred during another crime, and involved drug dealing or usage. Adolescent victims were also significantly more likely than both infant and child victims and middle and late child victims to have alcohol and drugs in their system at time of death. The results pertaining to the place characteristics were largely inconsequential.

Table 4. Multivariate Regression Examining the Factors that Distinguish Adolescent Victims Age 13–19 from Middle and Late Child Victims Age 6–12 (Reference), $N = 9346$ [a].

Variables	OR	95% CI
Victim Variables		
Female	0.56 ***	[0.45, 0.69]
Race and Ethnicity [b]		
African American	1.29	[0.94, 1.76]
Hispanic	1.10	[0.76, 1.61]
Had Recent History of Victimization	0.63	[0.34, 1.16]
Offender Variables		
Female	0.65 **	[0.50, 0.84]
Race and Ethnicity [b]		
African American	0.99	[0.69, 1.41]
Hispanic	0.88	[0.57, 1.35]
Had History of Abusing Victim	1.09	[0.74, 1.60]
Was Victim's Caregiver	0.25 ***	[0.19, 0.33]
Situational Characteristics		
Victim–Offender Relationship [c]		
Friend, Acquaintance, or Intimate Partner	7.58 ***	[5.63, 10.20]
Stranger	3.19 ***	[2.18, 4.65]
Incident Location [d]		
Outside Home or Apartment	3.75 ***	[2.94, 4.78]
Related to Intimate Partner Violence	0.90	[0.65, 1.25]
Followed Argument or Fight	1.98 ***	[1.54, 2.54]
Related to Gang Involvement	1.62 *	[1.09, 2.41]
Precipitated by Victim Weapon Use	7.75 ***	[2.52, 23.82]
Occurred During another Crime	0.88	[0.70, 1.10]
Related to Drug Dealing or Usage	1.82 **	[1.19, 2.78]
Victim Had Alcohol in System at Death	1.47 *	[1.00, 2.15]
Victim Had Drugs in System at Death	2.38 ***	[1.82, 3.11]
Place Characteristics		
Concentrated Disadvantage	1.02	[0.86, 1.20]
Residential Stability	1.00	[0.98, 1.01]
Racial and Ethnic Heterogeneity	1.74	[0.87, 3.46]

Abbreviation: OR = odds ratio; CI = confidence interval. [a] The models also include dummy variables representing year of death and "other" categories for race and ethnicity, victim–offender relationship, and incident location. [b] Reference = White; [c] Reference = Family; [d] Reference = Inside Home or Apartment. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ (two-tailed tests).

4. Discussion

Of the firearm homicide victims aged 0–19 years recorded in the NVDRS from 2003 to 2021, 3992 (30%) were infants and young child victims, 996 were middle and late child victims (7.5%), and 8350 (62.5%) were adolescent victims. This is consistent with prior research demonstrating a higher risk of homicide victimization in early childhood and late adolescence than during middle and late childhood [13,15], perhaps reflecting developmental differences in autonomy and social involvement. For example, infants and young children are highly dependent on parents, unable to avoid or report familial conflict, abuse, neglect, and personal victimization [19]. For adolescents, independence from the family unit, growing social networks, burgeoning romantic relationships, and risk-taking, while normative and biologically driven parts of development [21], increase the risk for victimization outside of the home. On the other hand, older children may be insulated: (1) from family and caregiver violence by newly gained independence, communication skills, and time spent away from home (e.g., in school); and (2) from peer violence because the risky relationships and behaviors that are normative during adolescence have not yet developed [22].

Investigating differences in the correlates of firearm homicide across these victim groups, the results of descriptive analysis and multivariate regression models indicated that the correlates of child and adolescent firearm homicide are developmentally patterned. The findings suggest notable differences in the correlates of firearm homicide between children (0–12 years), on the whole, and adolescents (13–19 years). In particular, children were more likely to be killed by family members and caregivers in the home, while adolescents

were more likely to be killed by friends, acquaintances, intimate partners, and strangers outside of the home. This is consistent with research substantiating parents and caregivers as the most common perpetrators of child homicide [14]. Additionally, adolescents were more likely than children to have arguments, gang involvement, criminal activity, or drugs precipitate the homicide, consistent with prior research [25,26]. Similarly, adolescents were more likely than children to have alcohol or drugs in their system at time of death, a normative development during adolescence [27].

While the most notable differences were between children and adolescents, there were nuanced differences in the correlates of firearm homicide between infant and early child victims (0–5 years) and middle and late child victims (6–12 years). For example, the odds of the homicide offender being the victim's caregiver were significantly higher among infant and early child victims than among middle and late child victims. Relatedly, the odds of the homicide offender being a family member of the victim were significantly higher among infant and early child victims. Further, infant and early child victims were more likely than middle and late child victims to have recent experiences with victimization and abuse by the offender.

Ultimately, differences in the correlates of firearm homicide across the victim groups reflect normative changes in physical and emotional development, autonomy, levels of family interaction, and friendship and romantic relationships. The observations herein affirm the importance of implementing developmentally appropriate violence prevention programs. This entails focusing on the factors that account for the greatest risk of firearm homicide victimization among each developmental group. For example, programs that target violent discipline in the home [28] and promote positive parenting practices [29] may be particularly influential in preventing infant and child homicide, when time spent in the home is amplified. Middle and late child homicide victimization may be prevented through communication and mandatory reporting, as well as by positive peer socialization, when time spent outside of the home is increasing and friendships are burgeoning. Adolescent homicide may best be deterred through community violence initiatives and dating violence prevention programs [30], as time spent outside of the home and with romantic partners intensifies.

Prevention programs should also take into account gender, race and ethnicity, and intervention locale. For example, spatial disparities in socioeconomic opportunities can produce neighboring areas within the same city that have markedly different firearm homicide rates [2]. Interventions in these neighboring areas may benefit from tailored approaches that take into account the unique challenges facing these communities and their residents, while also focusing on youth stages of development.

More broadly, it is important to consider gun control policies in other countries that have achieved significantly lower rates of firearm-related injuries and deaths than the U.S. For example, Australia's National Firearms Agreement (NFA) implemented a nationwide buyback program, strict licensing requirements, and a ban on semi-automatic weapons that reduced the number of firearms in circulation. In Japan, private firearm ownership is quite rare and involves a rigorous process, including background checks, interviews with references, gun safety training, and gun storage inspections. And the United Kingdon severely limits handgun purchases and has strict licensing requirements for other firearms [31].

The findings and study implications may be tempered by several limitations of the NVDRS. Notably, the data do not include the full population of firearm homicide deaths in the U.S. As Appendix A shows, not all states report data in each year of the study period and the majority of deaths in the study sample occurred in 17 states, limiting generalizability and preventing trend analysis [15]. Relatedly, given the paucity of data in each victim

group in any given year, the statistical approach in this study was to merge cases from 2003 to 2021, which treats the period as static and neglects potentially important social, political, and epidemiological changes over time. To address these potential shortcomings, the multivariate regression models control for year of death via a series of dummy variables. Additionally, sensitivity analysis by time period, most notably via the inflection point of 2015 after which 32 states began reporting to the NVDRS, revealed a very consistent pattern of results across time, lending credence to the analytical strategy. Also note that the focus on violent deaths in the NVDRS prevented the inclusion of a comparison group who did not die by firearm homicide. While beyond the scope of this study, including such a comparison group would allow for an examination of the factors that increase the risk for firearm homicide. Further, the contextual unit of analysis in the NVDRS is a census-designated place, but there is utility in examining the social context from a more granular lens, for example using census tracts, block groups, or blocks. Finally, by focusing on firearm homicide victims, this study excludes a considerable number of child and adolescent homicide victims who were killed by other methods. Indeed, in 2023, 749 children and adolescents aged 0–19 years, representing 20% of all homicides in this age group, were killed without a firearm [1]. Future research examining child and adolescent homicide should be "inclusive of, but not exclusive to, firearm homicide outcomes" [14].

5. Conclusions

With these limitations in mind, I conclude by reiterating the key observation that the correlates of child and adolescent firearm homicide victimization were developmentally patterned. Victim, offender, situational, and contextual characteristics varied in ways that aligned with autonomous stages of development. To prevent firearm homicide victimization among children and adolescents, violence prevention programs should be developmentally appropriate and reflect normative differences in physical and socio-emotional development, autonomy, levels of family interaction, and friendship and romantic relationships.

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Institutional Review Board Statement: Ethical review and approval were waived for this study because the CDC anonymized the NVDRS data prior to researcher access.

Informed Consent Statement: Informed consent was waived because the secondary data received from the CDC were de-identified.

Data Availability Statement: The National Violent Death Reporting System (NVDRS) data underlying the results presented in the study are available by request from the United States Centers for Disease Control and Prevention (CDC) as part of their restricted-access data process. My use of these restricted-access data—the National Violent Death Reporting System Restricted Access Database (NVDRS RAD file)—is governed by a Data Use Agreement (DUA) with the CDC. This DUA legally prohibits the sharing of these data with outside investigators. Anyone who wishes to gain access to these restricted access NVDRS data should contact nvdrs-rad@cdc.gov and follow the procedures outlined here: https://www.cdc.gov/nvdrs/about/nvdrs-data-access.html?CDC_AAref_Val=https://www.cdc.gov/violenceprevention/datasources/nvdrs/dataaccess.htmlcdc_data_surveillance_section_2-nvdrs-restricted-access-database-rad (accessed on 14 September 2025). Other NVDRS data are publicly available and can be accessed here: https://www.cdc.gov/nvdrs/about/nvdrs-data-access.-html?CDC_AAref_Val=https://www.cdc.gov/violenceprevention/datasources/nvdrs/dataaccess.htmlcdc_data_surveillance_section_1-wisqars-violent-deaths-nvdrs-module (accessed on 14 September 2025).

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Appendix A

Table A1. State Participation in the National Violent Death Reporting System (NVDRS) by Year, 2003–2021.

State	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Alabama																X	X	X	X
Alaska	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Arizona													X	X	X	X	X	X	X
Arkansas																		X	X
California															X [a]	X [b]	X [c]	X [d]	X [e]
Colorado		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Connecticut													X	X	X	X	X	X	X
Delaware															X	X	X	X	X
District of Columbia															X	X	X	X	X
Florida																		f	f
Georgia		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hawaii													X	X	e	e	X	f	f
Idaho																		X	X
Illinois														X [f]	X [f]	X [f]	X [f]	X	X
Indiana														X	X	X	X	X	X
Iowa														X	X	X	X	X	X
Kansas													X	X	X	X	X	X	X
Kentucky			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Louisiana																X	X	X	X
Maine													X	X	X	X	X	X	X
Maryland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Massachusetts	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Michigan												X	X	X	X	X	X	X	X
Minnesota													X	X	X	X	X	X	X
Mississippi																		X	X
Missouri																X	X	X	X
Montana																	X	X	X
Nebraska																X	X	X	X
Nevada															X	X	X	X	X
New Hampshire													X	X	X	X	X	X	X
New Jersey	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

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Table A1. *Cont.*

State	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
New Mexico			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
New York													X	X	X	X	[g]	X	X
North Carolina		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
North Dakota																	X	X	X
Ohio									X	X	X	X	X	X	X	X	X	X	X
Oklahoma		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Oregon	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pennsylvania														X [f]	X [f]	X [f]	X [f]	X	X
Puerto Rico															X	X	X	X	X
Rhode Island		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
South Carolina	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
South Dakota																		X	X
Tennessee																		X	X
Texas																		X [h]	X [i]
Utah			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vermont													X	X	X	X	X	X	X
Virginia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Washington														X [f]	X [f]	X	X	X	X
West Virginia															X	X	X	X	X
Wisconsin		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Wyoming																	X	X	X
Total	7	13	16	16	16	16	16	16	17	17	17	18	27	32	37	41	44	50	50

[a] Collected data for violent deaths that occurred in 4 counties (n = 1866; 27.8% of violent deaths in California in 2017), in accordance with requirements under which the state was funded. [b] Collected data for violent deaths that occurred in 21 counties (n = 3659; 55.1% of violent deaths in California in 2018), in accordance with requirements under which the state was funded. [c] Collected data for violent deaths that occurred in 30 counties (n = 3645; 55.3% of violent deaths in California in 2019), in accordance with requirements under which the state was funded. [d] Collected data for violent deaths that occurred in 35 counties (n = 4675; 68.1% of violent deaths in California in 2020), in accordance with requirements under which the state was funded. [e] Excluded from data years 2017, 2018, and 2020 due to incomplete case reporting. [f] Collected data on >80% of violent deaths in state, in accordance with requirements under which the state was funded. [g] Excluded from data year 2019 due to incomplete case reporting. [h] Collected data for violent deaths that occurred in 4 counties (n = 2741; 40.5% of violent deaths in Texas in 2020), in accordance with requirements under which the state was funded. [i] Collected data for violent deaths that occurred in 13 counties (n = 4327; 61.9% of all violent deaths in Texas in 2021), in accordance with requirements under which the state was funded.

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