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Trapped in Violence: A Life Table Analysis of Firearm Injury and Death Among Adolescent Black Males

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Abstract

Purpose: We report the chances of 14-year-old males becoming victims of firearm injury or death before age 25 in Philadelphia, Pennsylvania.

Methods: Using life table methods, we followed 4,501 Black males aged 14 years, and a comparison group of 1,751 White males, over 11 years.

Results: Among 14-year-old Black males, the risk of a nonfatal firearm injury before age 25 was 10.1% (95% confidence interval, 9.2%–11.0%), the risk of death from firearms was 2.5% (1.7%–3.2%), and the combined risk was 12.5% (11.0%–14.1%). Among White males, the risk of nonfatal firearm injury was 0.8% (0.3%–1.2%), the risk of death was 0.3% (0.02%–0.5%), and the combined risk was 1.0% (0.5%–1.5%).

Discussion: Risk estimates reveal the dire likelihood of firearm injury or death among Black adolescent males in Philadelphia. Immediate interventions are needed to de-escalate conflicts, provide supports, and address the upstream causes of violence like poverty and structural racism.

Keywords

Adolescents; Black males; Cumulative risk; Fatal firearm injuries; Life table; Nonfatal firearm injuries; Racial disparity; White males; Young adults

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Firearm injuries are the leading cause of death for Black male adolescents and young adults in the United States [1]. In the 14–24 age group, the firearm fatality rate in Philadelphia, Pennsylvania, was 235 per 100,000 in 2022, down from 302 during the pandemic peak in 2020 [2]. While firearm injury and death rates are valuable for tracking population-level changes, they lack intuitive meaning, a relatable scale to interpret the harms they represent (e.g., is 235 per 100,000 moderate, high, or extremely high?). To better understand and communicate the severity of firearm-related harms among young Black males in Philadelphia, we built an actuarial table to estimate the cumulative risk of injury or death. We report the chances of Black males aged 14 years becoming victims of firearm injury or death before age 25, alongside a comparison group of White males.

Methods

We estimated the risk of firearm injury or death for non-Hispanic Black males aged 14–24 years using standard period life table methods [3]. A period life table reflects what would happen to a hypothetical cohort if it experienced the prevailing age-specific probabilities of injury or death. In our hypothetical cohort, we followed 4,501 individuals (the population of all 14-year-old Black males in the city and county of Philadelphia) for 11 years beginning January 2022. To construct the table, we first estimated the number of individuals surviving from one year to the next by multiplying the cohort population size at each age, starting at age 14, by 1 minus the probability of death from all causes at that age. Philadelphia all-cause death probabilities were obtained from the National Vital Statistics System (NVSS) [2]. We then applied 2022 age-specific firearm injury and death rates of Philadelphia Black males to the cohort population to estimate the expected number of injuries and deaths. Firearm victimization data were obtained from the Philadelphia City Controllers' Office [4], the incident information extracted from detective reports processed by the Statistics Unit in the Philadelphia Police Department. The firearm injury data encompass all categories of intent-assault, self-harm, unintentional, legal interventions, and undetermined-and all levels of injury severity. Philadelphia 2020 Census population estimates [5], the denominators in the firearm injury and death rates, were adjusted for the undercount of Black individuals [6] and shifted from a mid-year to a January 1 timeframe. Finally, we summed the expected number of injuries and deaths from age 14 through age 24 years and computed the risk estimates and confidence intervals. We used identical procedures to generate risk estimates for a comparison group of 1,751 Philadelphia non-Hispanic White males. This study used publicly available, deidentified data. Consistent with guidance from the University of Pennsylvania Institutional Review Board, it did not require human subjects review.

Results

Of the 4,501 Black males aged 14 years in the cohort at baseline, the cumulative risk of nonfatal firearm injury was 10.1% (95% confidence interval [CI], 9.2%–11.0%) or one in 10 individuals (Table 1). The cumulative risk of death from firearms was 2.5% (95% CI, 1.7%–3.2%) or one in 40 individuals. The cumulative risk of either fatal or nonfatal firearm injury was 12.5% (95% CI, 11.0%–14.1%) or one in eight individuals.

Of the 1,751 White males aged 14 years in the cohort at baseline, the cumulative risk of nonfatal firearm injury was 0.8% (95% CI, 0.3%–1.2%) or one in 133 individuals (Table 2). The cumulative risk of death from firearms was 0.3% (95% CI, 0.02%–0.5%) or one in 376 individuals. The cumulative risk of either fatal or nonfatal firearm injury was 1.0% (95% CI, 0.5%–1.5%) or one in 98 individuals.

Discussion

At current rates, 12.5% or one in eight adolescent Black males in Philadelphia will experience a fatal or nonfatal firearm injury before age 25, compared to 1% or one in 98 White males. The estimates make clear that firearm violence pervades the lives of young Black people in Philadelphia, resulting not only in death and physical disability but psychological trauma, increased healthcare use, and despairing families. Furthermore, each shooting increases the perception that carrying a gun is necessary for self-defense [7–9]. As young people arm themselves, primarily for their own protection, more guns appear in the community, raising the incentive for any single individual to arm themselves, trapping Black youth in a cycle of mutual armed suspicion [10]. The use of guns for self-defense and conflict resolution is consistent with NVSS death certificate data which show that, for boys and young men, 90% of the firearm deaths in Philadelphia were homicides in 2022; the remainder, in order of frequency, were suicide, legal intervention (police officer-involved shootings), and undetermined [2].

Data on the immediate motives driving homicides (arguments, retaliation, and drugs) can inform interventions aimed at teaching nonviolent responses to volatile situations [11]. Social supports like mentorship programs, summer employment, and trauma-informed therapy and wrap-around services can help buffer the impacts of community violence [12–14], but to achieve large-scale reductions in firearm deaths, investments must target the upstream causes of violence, including poverty, inequality, and structural racism [15,16].

Strengths of the study include the use of cumulative risk estimates that effectively communicate the risk of injury and death from firearms. Research shows that numerical formats that are easy to interpret enhance the perceived immediacy and likelihood of the risk [17,18], thereby mobilizing community members and policymakers. Another strength is the increasing relevance of life table methods as more jurisdictions share firearm injury data [19]. That said, we note that life table calculations involve a few more steps than traditional mortality rates.

This study has several limitations. First, the low rate of firearm fatalities among White adolescents (0.3%) resulted in wide confidence intervals for the risk estimate, indicating a higher level of uncertainty. Second, the study uses US Census Bureau's county population estimates from 2020, categorized by race, ethnicity, sex, and single-year age. While these figures are the latest available at this level of detail, they are slightly out of date, which could minimally affect the accuracy of the risk calculations. Third, the risk estimates were calculated for the entire city; however, we expect them to be higher in Philadelphia's poorest and most segregated zip codes, known hotspots for firearm violence. Our data are not detailed enough to permit life table analyses at the neighborhood or zip code level. Finally,

although we could not independently assess the completeness of the City Controller's data on nonfatal shootings, our analysis found that the count of fatalities from shootings in this dataset was slightly higher than the provisional numbers reported by the NVSS for 2022.

In the face of the seemingly insurmountable problem of interpersonal firearm-related harms, we must change the narrative to mobilize all stakeholders. This study provides a rigorous approach to projecting what will happen in the near future to a cohort of Black 14-year-old boys if current rates continue. This forward-looking method enables us to humanize these young teenagers, to see the dangers they will face, by showing the likelihood of injury or death before they reach adulthood.

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IMPLICATIONS AND CONTRIBUTION

This actuarial study estimates the likelihood of a 14-year-old male in Philadelphia becoming a victim of firearm injury or death before age 25. Findings indicate a 12.5% risk for Black male adolescents and 1% for White male adolescents. Life tables provide a straightforward metric for understanding risk severity and disparity.

Hypothetical cohort of Black males aged 14 years with 11-year follow-up: estimates of the probability of injury or death from firearms before age 25 years^a

Age interval	All-cause mortality rate	Hypothetical cohort of Black males in Philadelphia: population alive at beginning of each age interval	Nonfatal firearm injury rate	Number of expected nonfatal firearm injuries	Fatal firearm injury rate	Number of expected fatal firearm injuries	Number of expected fatal and nonfatal firearm injuries
14–15	0.0000	4,501	0.0032	14.2	0.0000	0.0	14.2
15–16	0.0002	4,501	0.0039	17.6	0.0002	1.0	18.6
16–17	0.0018	4,500	0.0075	33.9	0.0011	5.0	38.9
17–18	0.0025	4,492	0.0109	48.9	0.0019	8.3	57.2
18–19	0.0049	4,481	0.0119	53.3	0.0036	16.3	69.6
19–20	0.0047	4,459	0.0113	50.3	0.0035	15.7	66.0
20–21	0.0043	4,438	0.0119	52.8	0.0037	16.2	69.0
21–22	0.0059	4,419	0.0123	54.3	0.0039	17.1	71.4
22–23	0.0031	4,393	0.0086	37.9	0.0024	10.7	48.6
23–24	0.0041	4,379	0.0107	46.7	0.0026	11.2	57.9
24–25	–	4,361	0.0100	43.4	0.0022	9.8	53.2
			Total	453.4		111.4	564.8
			Cumulative risk (95% CI)	10.1% (9.2%–11.0%)		2.5% (1.7%–3.2%)	12.5% (11.0%–14.1%)
			100/cumulative risk (95% CI)	10 (9–11)		40 (31–57)	8 (7–9)

CI = confidence interval.

^aEstimates are rounded.

Table 2

Hypothetical cohort of White males aged 14 years with 11-year follow-up: estimates of the probability of injury or death from firearms before age 25 years^a

Age interval	All-cause mortality rate	Hypothetical cohort of White males in Philadelphia: population alive at beginning of each age interval	Nonfatal firearm injury rate	Number of expected nonfatal firearm injuries	Fatal firearm injury rate	Number of expected fatal firearm injuries	Number of expected fatal and nonfatal firearm injuries
14–15	0.0006	1,751	0.0000	0.0	0.0006	1.0	1.0
15–16	0.0011	1,750	0.0000	0.0	0.0006	1.0	1.0
16–17	0.0006	1,748	0.0000	0.0	0.0000	0.0	0.0
17–18	0.0006	1,747	0.0011	2.0	0.0000	0.0	2.0
18–19	0.0000	1,746	0.0010	1.8	0.0000	0.0	1.8
19–20	0.0005	1,746	0.0008	1.3	0.0005	0.9	2.2
20–21	0.0007	1,745	0.0014	2.4	0.0007	1.2	3.6
21–22	0.0013	1,744	0.0017	2.9	0.0000	0.0	2.9
22–23	0.0020	1,742	0.0004	0.7	0.0000	0.0	0.7
23–24	0.0006	1,738	0.0006	1.1	0.0003	0.6	1.7
24–25	–	1,737	0.0005	0.9	0.0000	0.0	0.9
Total				13.2		4.7	17.8
Cumulative risk (95% CI)				0.8% (0.3%–1.2%)		0.3% (0.02%–0.5%)	1.0% (0.5%–1.5%)
100/cumulative risk (95% CI)				133 (86–287)		376 (197–4,055)	98 (67–182)

CI = confidence interval.

^a Estimates are rounded