Gun violence among young adults with a juvenile crime record in North Carolina: Implications for firearm restrictions based on age and risk

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ABSTRACT

Youth who acquire a juvenile crime record may be at increased risk of perpetrating gun violence as adults. North Carolina and 22 other states permit young adults who were adjudicated by a juvenile court – even for some felony-equivalent offenses – to legally access firearms. Effectiveness of gun restrictions for adults with juvenile crime histories has not been systematically studied. This article reports findings from a longitudinal study of arrests and convictions for gun-involved and other offenses in 51,059 young adults in North Carolina, comparing those with gun-disqualifying and not-disqualifying juvenile records. The annualized rate of arrest for gun-involved crime in those with a felony-level juvenile record was 9 times higher than the rate of reported comparable offenses in the same age group in the North Carolina general population (3349 vs. 376 per 100,000). Among those with a felony-equivalent juvenile delinquency adjudication who became legally eligible to possess firearms at age 18, 61.8% were later arrested for any criminal offense, 14.3% for a firearm-involved offense. Crimes with guns were most likely to occur among young adults who had committed more serious (felony or equivalent) offenses before age 18; had been adjudicated at younger ages; acquired a felony conviction as a youth; and spent time in prison. The prevalence of arrests for crimes involving guns among young adults in North Carolina with a gun-disqualifying felony record acquired before age 18 suggests that the federal gun prohibitor conferred by a felony record is not highly effective as currently implemented in this population. From a risk-based perspective, these restrictions appear to be justified; better implementation and enforcement may improve their effectiveness. Gun crime prevention policies and interventions should focus on these populations and on limiting illegal access to firearms.

1. Introduction

Regulatory strategies to prevent gun violence in the United States have long relied on selective, point-of-sale firearm prohibitions applied to certain categories of putatively dangerous or "unvirtuous" (Charles, 2019) individuals, such as those convicted of a serious crime, or those considered to be incompetent or not responsible for their actions, such as children. (USA. Gun Control Act of 1968, 1968; Giffords Law Center to Prevent Gun Violence, n.d.-a) Gun restrictions linked to a person's age

and their criminal history intersect in complex ways for U.S. youth who are arrested before their 18th birthday. Their offenses can be adjudicated in the juvenile justice system or referred to an adult criminal court for prosecution, depending on the severity of offense, the age of the accused youth at the time of the offense, and widely varying state laws, public policies, and the practices of local prosecutors and judges. Alternative legal pathways may or may not result in a future firearm prohibition, and little research has examined the effect of such policies. Empirically valid and specific estimates of the magnitude and

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trajectories of gun violence risk in the affected populations are also lacking. This article begins to fill these policy-relevant knowledge gaps.

1.1. Young adults with a record of juvenile delinquency adjudication or criminal conviction as a special population of concern for gun violence prevention policy

A key feature of the Bipartisan Safer Communities Act of 2022 (Bipartisan Safer Communities Act, 2022) is a provision for an enhanced background check process that applies specifically to prospective firearm purchasers under age 21. As this law takes effect, whenever a person in that age group applies to purchase a gun from a licensed dealer, the FBI's National Instant Check System (NICS) will initially have three business days to conduct an enhanced search of potentially disqualifying records in state databases, including a search of juvenile justice records (where they might be available.) In cases where the initial enhanced search reveals a possible gun-disqualifying record, NICS will then have an extended window of up to ten days to complete a more thorough investigation to confirm or deny the prospective buyer's legal eligibility to access firearms. Even if the person is eventually found to be eligible to purchase a gun, the policy will function as a "waiting period" for individuals with at least some evidence suggesting a gun-disqualifying juvenile crime record. This policy invites a relevant question that our study can help answer: *What is the rationale behind focusing this new firearm-access policy on young people who might have a juvenile crime record, and is it likely to be effective?*

Young people, as a group, are at elevated risk of violent behavior, for reasons generally attributed to a combination of biological and developmental processes and social and situational determinants of crime that tend to concentrate in this population (Office of the Surgeon General (US); National Center for Injury Prevention and Control (US); National Institute of Mental Health (US); Center for Mental Health Services (US). Youth Violence: A Report of the Surgeon General. Rockville (MD): Office of the Surgeon General (US), 2001). The pattern of elevated risk associated with younger age is seen in U.S. crime statistics. Young people in their teens and twenties account for nearly half of all violent crime arrests (Federal Bureau of Investigation, 2020a), and many of those arrested were involved with the justice system beginning in early adolescence. In 2020, most homicides were perpetrated by individuals ages 17 to 29. Approximately 1 in 4 arrests for weapons offenses involved a suspect age 21 or younger (Federal Bureau of Investigation, 2020b). In the U.S., the rate of arrest for violent crime generally increases steadily with age, beginning at ages 10 to 12 and accelerating steeply through the teenage years and into the early twenties before leveling off and declining after age 25 for the remainder of the life course. In addition to the risk associated with immaturity in normal development, individuals who engage in violent acts and other illegal behavior as children may have diagnosable conduct disorder, which can be caused in part by abnormal brain development and often persists into adulthood in the form of antisocial personality disorder; many adults with long criminal careers had conduct disorder as children (Fairchild et al., 2019).

Social-environmental determinants of violent behavior in young adults include the sequelae of traumatic childhood experiences, poverty, family conflict, stressful life events, deviant peer influences, and exposure to community violence (MacMillan, 2001); these can interact with developmental and biological vulnerabilities, including psychiatric conditions such as depression, substance misuse and some personality disorders. Prior arrest, incarceration, and access to firearms in the community also are strong predictors of future criminal offending. (Stolzenberg et al., 2021; Emmert et al., 2018) Longitudinal research is needed to examine gun-related crime in justice-involved youth as they traverse early adulthood with these concentrated risk factors, to better understand the context, challenges, and limitations of age- and crime-based firearm restrictions as a strategy to prevent gun violence.

1.2. Justice system context for firearm prohibition in young adults with a juvenile crime history, and why this matters

A focus on justice-involved young people is highly relevant for gun violence prevention policy. Approximately 800,000 individuals under age 18 are adjudicated as juvenile delinquents or convicted of crimes in the U.S. each year (Hockenberry and Puzzanchera, 2021), acquiring a legal record that correlates with future criminal behavior (Basto-Pereira et al., 2016). For these individuals, especially those with conduct or antisocial personality disorders, access to firearms can be a significant aggravating factor in a trajectory of continued criminal offending, both in terms of legal consequences and public safety. Robust secondary gun markets in the U.S. enable many gun-prohibited young people to obtain firearms through illicit means (Pierce et al., 2006).

When a person under age 18 is arrested in the U.S., the legal resolution of the matter can directly affect the young person's eligibility to purchase and possess firearms when they become an adult. Whereas federal law prohibits all individuals with a felony conviction from accessing firearms, state laws may or may not apply gun restrictions to young adults with an adjudicated juvenile delinquency record – even when the delinquent act in question would have been treated as a gun-disqualifying felony if committed by an adult.

As we have already suggested, macro-level variation in state laws, policies, and practices can exert a significant micro-level effect on accused individuals' chances of receiving a given disposition in their state's respective juvenile justice or criminal legal systems – from community supervision, to juvenile detention, to imprisonment in the adult penal system. Harsher dispositions may disqualify a young person from legally accessing firearms in the future, but may indirectly contribute to their exposure to socially toxic institutional environments, deviant peer groups, illegal gun markets, and other criminogenic factors that increase their risk of future firearm-involved violence. Past research suggests that youth who acquire a permanent record of criminal conviction and spend time in prison are at substantially increased risk of repeated criminal behavior compared to their counterparts who were adjudicated in juvenile court (Aizer and Doyle, 2015).

All U.S. states have provisions for expunging, sealing, or otherwise protecting juvenile justice records as confidential, thereby giving young adults with this background a fresh start, free from the social penalty of a criminal history. Such policies are well intended and largely beneficial, but could negatively affect public safety when applied to gun rights. Specifically, expungement of delinquency records can enable an 18-year-old to legally purchase a firearm despite having committed a serious offense at age 17 – an offense which, if it had been committed by an adult would have resulted in a permanently gun-disqualifying felony conviction. This concern has prompted 28 states to enact laws that prohibit or delay the purchase or possession of firearms by persons who were adjudicated for delinquency in their youth. (Giffords Law Center to Prevent Gun Violence, n.d.-b; Gardner et al., 2022)

North Carolina is not among those states. However, before 2019 North Carolina had a policy of mandatory referral of 16- and 17-year-old defendants to criminal court, which created a large group of young adults with gun-disqualifying felony convictions. While the negative consequences of this policy have been amply described, (Scialabba, 2016; Kazemian, 2021) the possibility that the firearm restriction attached to a felony record might have had some counterbalancing protective effect has not been formally examined. An informative and policy-relevant comparison can be made by observing criminal outcomes for subgroups of young adults who were all arrested as minors but treated differently by the law, based on their age at offense, resulting in differential access to firearms when they became adults.

The existing unsettled legal landscape surrounding the regulation of access to firearms for young adults with a juvenile crime record invites several specific policy-relevant questions for research: 1) *How prevalent is gun-related violence among young adults with a record of juvenile offending, relative to their peers in the general population? 2) How does risk*

of gun violence change with age, over the transition from adolescence into young adulthood, in youth with differing juvenile crime backgrounds – those with misdemeanor- vs. felony-equivalent records, and in those adjudicated in juvenile vs. adult criminal court? 3) To what extent does the age at first adjudication or conviction as a juvenile affect adult criminal outcomes, that is, future arrests and convictions for gun-related and non-gun-related offenses?

We address these questions by analyzing a longitudinal criminal record database pertaining to a study population of 51,059 young adults in North Carolina who were adjudicated in juvenile court or convicted in criminal court before age 18. We examine the risk-based rationale for, and possible consequences of, one state's legal approach to firearm eligibility and restriction for young adults with a juvenile crime history. We describe patterns of arrest and conviction for firearm-involved crime and other crime through the early years of their adulthood. We consider the implications of our findings for age-based firearm restrictions and a possible rationale for extending the minimum age requirement for purchasing and possessing firearms by individuals with an adjudicated juvenile delinquency record, as many states already do.

2. Methods

2.1. Study design

The study assembled a database of linked state agency records to describe the longitudinal frequency of gun-related and other criminal charges and convictions in a large population of young adults in North Carolina ($N = 51,099$) with criminal offenses or juvenile delinquency adjudications occurring before age 18. We designed 3 sets of analyses to address the research questions set forth above. First, we compared the rate of firearm-involved violent crime in the study population to that of their age peers in the general population (Analysis 1). Next, we estimated legal system predictors of gun-related crime in young adults with a juvenile crime history, using categorical regression analysis with mutually exclusive classification of juvenile record status at age 18 (Analysis 2). Finally, we estimated the effect of early vs. later initiation of juvenile offending on the risk of adult criminal offending, its severity, and the involvement of firearms; we compared criminal outcomes for subgroups of young adults who had a single felony conviction or felony-equivalent adjudication at age 13, 14, 15 and 16 (Analysis 3).

2.2. Setting, study population, data sources, and matching

The study team assembled, matched, and linked longitudinal administrative record data from multiple North Carolina agencies. The database was designed to enable a statistical description and multivariable analysis of the incidence and patterns of change in criminal outcomes for justice-involved youths through the first 5 to 10 years of adulthood. Eligible individuals were born between 1990 and 1995; were recorded in the North Carolina Educational Research Data Center (NCERDC), which included all students enrolled in North Carolina public schools; and prior to age 18 were convicted of a misdemeanor or felony in criminal court or adjudicated in juvenile court for an equivalent offense. Observation began in the month following the first eligible offense before age 18 and continued through 2018, or the month of death, for a total 4.9 million person-month observations. At the end of follow-up, cohort members were between 23 and 28 years of age.

Data were assembled from the NCERDC for baseline fixed variables including demographic characteristics, economic disadvantage, academic achievement in math and reading, parental education, and records of school suspension; North Carolina Division of Juvenile Justice (DJJ) for juvenile adjudications and offense characteristics (violence, severity, firearm involvement); North Carolina Administrative Office of the Courts Automated Criminal Infractions Systems (ACIS) for criminal convictions and arrests, offense characteristics; North Carolina Department of Corrections (DOC) for state prison incarcerations; and Division

of Public Health (DPH) for death records. Duke University's Institutional Review Board approved the study (#2018–0615).

Linkage of the source datasets was performed by data specialists at the NCERDC using well-established protocols to minimize error and maximize reliability, while ensuring privacy of records. The process began with identification of the total age-eligible cohort of public school students born between 1990 and 1995. Then, using crosswalk identifier datasets, the education cohort data were linked to ACIS, DOC, DJJ, and DPH data. ACIS and DOC records were matched using a unique identification number assigned by the NC Administrative Office of the Courts. Otherwise, matching protocols used exact name and date of birth and a hierarchy of probabilistic matching rules. The matching and analytic cohort selection process are further described in Supplement Fig. 1 (Appendix).

For comparison to the general population (Analysis 1), we used North Carolina State Bureau of Investigation (NCSBI) (North Carolina State Bureau of Investigation, 2021) data on the number of firearm-involved violent crimes that are reported by local law enforcement agencies each year; Federal Bureau of Investigation (FBI) (Federal Bureau of Investigation, 2020c) data on the number of individuals at each chronological year of age who were arrested for any violent crime; and U.S. Census (Census Bureau, 2020) estimates of state population size, by age group and year.

2.3. Variables and measurement

The key dependent variables of interest were arrest and conviction after age 18 for gun-involved and not gun-involved offenses. To classify crimes as gun-involved, we first relied on specific mentions of any type of firearm in the text of the statutory code associated with the arrest. Because some gun crimes are charged using statutes with more general language about weapons, we developed a second variable that captured possible gun crime. This two-variable strategy allowed us to estimate outcome ranges and supported sensitivity analysis comparing results of a narrow definition that may underestimate gun involvement in crime and a broader definition that may overestimate it.

The variables for Analysis 1 were the annualized arrest rate (number of arrests per 100,000 per year) for firearm-involved violent crime among 18–24 year-olds in the study population and an estimated rate for the general population in the same age group, derived from publically available reports from the NCSBI, the FBI, and U.S. Census (described below.) The key independent variable for Analysis 2 was the classification of individuals into one of four legal-record status groups before turning 18, derived by cross-tabulating severity of offense (misdemeanor vs. felony crime or delinquency equivalent) and court level (juvenile vs. criminal court). Finally, for Analysis 3, the key independent variable was the age of first offense: 13, 14, 15, or 16.

Across all analyses, disqualification from firearm purchase was based on review of applicable state and federal law using available criminal court data on felony convictions, felony indictments, evidence of protective or restraining orders, unlawful drug use, and misdemeanor domestic violence convictions. Individuals were coded as gun-disqualified beginning the month after their disqualifying event.

Demographic variables for the study population, including race and economic status, were provided in the NCERDC data pertaining to public school students. The race variable reflects students' self-identification with one or another racial group, coded according to standard preexisting U.S. Census categories. We used four categories: non-Hispanic White, Black or African American, Hispanic, and Other (a combined residual category containing 5.7% of the study population). Economic disadvantage was defined operationally in the NCERDC database as living in a household with a total income below 185% of the federal poverty level. Other independent variables were measured using self-explanatory categories presented in the tables.

2.4. Statistical analyses

All analyses were performed in R and SAS 9.4. Three sets of comparative analyses were designed to address the study's research questions, described below.

2.4.1. Analysis 1. Comparing the rate of firearm-involved violent crime in the study population members to that of their age peers in the general population

To produce a general population estimate, we first used FBI data to calculate the proportion of violent crimes that were committed by 18–24 year-olds in 2019. We extrapolated that proportion to the total reported number of gun-related violent crimes in North Carolina in 2019. We divided the estimated number of gun-involved violent crimes attributable to 18–24-year-olds in North Carolina in 2019 by the U.S. Census estimate of the state's population in that age bracket, and multiplied the dividend by 100,000 – yielding an estimate of the population rate of violent gun crimes per 100,000 in the general population of 18–24-year-olds in North Carolina.

We then developed comparable rates for 18–24-year-olds in our study population who had a juvenile felony-equivalent adjudication or an adult felony conviction at age 14–17 years; this corresponds to the policy-relevant population that is subject to a firearm prohibition in 28 states. We divided our study's calculated number of arrests for violent firearm-involved crimes in that age group by the total number of person-month observations for the group, multiplied the dividend by 100,000, and multiplied that product by 12 to annualize the monthly rate. To obtain a risk ratio comparing the study population's rate of gun crime to that of their age peers in the general population, we divided the calculated study population rate by the estimated general population rate. We also present the rate of firearm-involved violent crime arrests for the subgroup of individuals who received a felony conviction at age 16 or 17, causing them to be prohibited from purchase and possession of firearms in adulthood, and we compare that rate to the general population estimate.

The measure assumes that the proportion of 18–24-year-olds in the FBI's national total of arrests for violent crime can be applied specifically to North Carolina and to the subset of violent crimes that involve firearms. Notably, the NCSBI data are based on all reported crimes while the study data reflect actual arrests. Not all reported crimes result in an arrest. Thus, the risk ratios are comparing a subset of reported crimes in the study population to the full count of reported crimes in the general population, which is likely to underestimate the magnitude of increased crime risk in the study population compared to the general population.

2.4.2. Analysis 2. Examining trends in arrests and convictions and estimating legal system predictors of gun-related crime in young adults with a juvenile crime history: categorical regression analysis with mutually exclusive classification of juvenile record status at age 18

In Analysis 2, we examined the association between gun-related and non-gun-related crimes in young adults from age 18 through the end of follow up (age 23–28). We compared four mutually exclusive groups of individuals whose most serious adjudicated charge placed them into one of the following categories at age 18: (A) misdemeanor-equivalent juvenile delinquency record; (B) felony-equivalent juvenile delinquency record; (C) misdemeanor conviction record in criminal court; and (D) felony conviction record in criminal court. Individuals were classified by their most serious juvenile record status at age 18 (D, B, C, A). Two subgroups of group (D) were also defined, those who were not incarcerated (D1) and incarcerated (D2) before age 18. Under North Carolina law in effect during the study period, individuals in groups (A), (B), and (C) became eligible to purchase and possess firearms at age 18; those in group (D), including subgroups (D1) and (D2), remained permanently disqualified from accessing firearms under federal law.

Descriptive counts and percentages of individuals in the comparison groups and with relevant characteristics were produced using simple frequency procedures. Bivariate associations between categorical variables were tested with Pearson's Chi-Square. Bivariate and covariate-adjusted odds ratios with 95% confidence intervals (CI) were reported for regression analyses. In multivariate analyses, missing data for covariates were handled using missingness indicator variables. Recent research using simulations by Song and others has shown that the bias induced by missingness indicators is quite small (Song et al., 2021; Tong et al., 2020) and would support the validity of our indicators.

We conducted generalized estimating equation (GEE) logistic regression analysis to account for within-person repeated measures, using an exchangeable working correlation. We removed all person-time observations corresponding to episodes of incarceration, when individuals were not in the community. Unadjusted and covariate-adjusted models were fitted. Covariates in the adjusted models included birth cohort, sex, race, economic disadvantage, academic achievement in reading and math by 8th grade (grade level vs. below grade level) parental education, and any record of school suspension.

2.4.3. Analysis 3. Estimating the effect of early vs. later initiation of juvenile offending on the risk of adult criminal offending, its severity, and the involvement of firearms

Analysis 3 was designed to examine the association between the age of initiation of juvenile crime and the risk of adult crime, its severity, and the involvement of firearms. For this analysis, the study population was classified into 4 groups corresponding to the age of first juvenile felony-equivalent offense or criminal felony conviction: age 13, 14, 15 or 16. Within these categories, all had juvenile adjudications except the 16-year-olds, who were convicted in adult criminal court pursuant to North Carolina policy at that time. To render the groups comparable regarding the potential cumulative effects of repeated juvenile crime on adult criminal offending, this analysis was limited to individuals with only one adjudication or conviction occurring before age 18. This analysis used the modeling technique described for Analysis 2.

3. Results

3.1. Cohort characteristics

School records of students' demographic characteristics showed that our justice-involved study population was disproportionately male (73.8%) and from nonwhite racial minority groups (58.0%) when compared with North Carolina's general population in the same years and age groups (50.9 males, 40.0% nonwhite racial minorities; Table 1) (Census Bureau, n.d.). The majority of the study cohort – 73.1% – were from an economically disadvantaged background. Approximately 4 out of 10 individuals in the study population (40.1%) scored below-grade-level proficiency in 8th grade reading and slightly more than half (51.2%) had below-grade-level proficiency in 8th grade math; the comparable proportions in the general population of North Carolina 8th graders in 2008 were 44.3% and 30.2%, respectively. Seventy-one percent of the study population had received a school suspension.

3.2. Results of Analysis 1. Comparing the rate of firearm-involved violent crime in the study population to that of their age peers in the general population

In the study population, the annual arrest rate for a violent crime involving a firearm among 18–24-year-olds with a record of a felony-equivalent juvenile delinquency adjudication or felony criminal conviction was 3349 (estimated range 2822–3877) per 100,000. The rate was considerably higher in the subgroup who were legally ineligible to purchase and possess firearms due to a felony conviction: 6461 (estimated range 4689 - 8233) per 100,000. For comparison, in the general population of 18–24-year-olds, the annual rate of reported firearm-involved crime was 376 per 100,000 (using NCSBI, FBI, and US Census data). The risk ratio for violent gun crime in the study population

Table 1
Sample characteristics and adult criminal outcomes.

		Total sample		Criminal outcomes at age 18 and older									
				Any criminal offense				*Any firearm-related offense*				*Non-firearm related offense only*			
				Arrest		Conviction		Arrest		Conviction		Arrest		Conviction	
Sample characteristics		N	(Pct.)	N	(Pct.)	N	(Pct.)	N	(Pct.)	N	(Pct.)	N	(Pct.)	N	(Pct.)
Birth year	1990	10,285	(20.1)	8354	(81.2)	6465	(62.9)	1453	(14.1)	748	(7.3)	8336	(81.1)	6432	(62.5)
	1991	9920	(19.4)	7742	(78.0)	5875	(59.2)	1293	(13.0)	611	(6.2)	7726	(77.9)	5854	(59.0)
	1992	9462	(18.5)	7121	(75.3)	5236	(55.3)	1172	(12.4)	587	(6.2)	7105	(75.1)	5197	(54.9)
	1993	8524	(16.7)	6209	(72.8)	4418	(51.8)	980	(11.5)	485	(5.7)	6191	(72.6)	4390	(51.5)
	1994	7211	(14.1)	5081	(70.5)	3449	(47.8)	736	(10.2)	349	(4.8)	5061	(70.2)	3421	(47.4)
	1995	5657	(11.1)	4094	(72.4)	2755	(48.7)	608	(10.7)	324	(5.7)	4073	(72.0)	2723	(48.1)
Latest observed age in follow-up data	<23	1093	(2.1)	914	(83.6)	748	(68.4)	296	(27.1)	173	(15.8)	897	(82.1)	735	(67.2)
	23	5747	(11.3)	4202	(73.1)	2865	(49.9)	662	(11.5)	357	(6.2)	4187	(72.9)	2832	(49.3)
	24	7248	(14.2)	5138	(70.9)	3530	(48.7)	788	(10.9)	377	(5.2)	5119	(70.6)	3501	(48.3)
	25	8398	(16.5)	6114	(72.8)	4351	(51.8)	957	(11.4)	473	(5.6)	6098	(72.6)	4325	(51.5)
	26	9256	(18.1)	6947	(75.1)	5100	(55.1)	1138	(12.3)	574	(6.2)	6933	(74.9)	5064	(54.7)
	27	9611	(18.8)	7468	(77.7)	5638	(58.7)	1196	(12.4)	573	(6.0)	7455	(77.6)	5618	(58.5)
	28	9706	(19.0)	7818	(80.5)	5966	(61.5)	1205	(12.4)	577	(5.9)	7803	(80.4)	5942	(61.2)
Sex	Female	13,396	(26.2)	9637	(71.9)	5734	(42.8)	325	(2.4)	100	(0.8)	9630	(71.9)	5725	(42.7)
	Male	37,663	(73.8)	28,964	(76.9)	22,464	(59.6)	5917	(15.7)	3004	(8.0)	28,862	(76.6)	22,292	(59.2)
Race	Non-Hispanic white	21,456	(46.9)	16,015	(74.6)	11,132	(51.9)	1502	(7.0)	669	(3.1)	15,994	(74.5)	11,103	(51.7)
	Black	21,388	(41.9)	16,486	(77.1)	12,846	(60.1)	4170	(19.5)	2178	(10.2)	16,417	(76.8)	12,710	(59.4)
	Hispanic	5331	(10.4)	3954	(74.2)	2696	(50.6)	247	(4.6)	109	(2.0)	3940	(73.9)	2687	(50.4)
	Other	2887	(5.7)	2146	(74.4)	1524	(52.8)	323	(11.2)	148	(5.1)	2141	(74.2)	1517	(52.6)
8th grade math achievement	Below grade level	19,909	(39.0)	15,581	(78.3)	11,934	(59.9)	2992	(15.0)	1499	(7.5)	15,523	(78.0)	11,845	(59.5)
	Grade level or above	18,984	(37.2)	15,289	(80.5)	10,250	(54.0)	1743	(9.2)	832	(4.4)	15,265	(80.4)	10,201	(53.7)
	Missing	12,166	(23.8)	7731	(63.5)	6014	(49.4)	1507	(12.4)	773	(6.4)	7704	(63.3)	5971	(49.1)
8th grade reading achievement	Below grade level	15,533	(30.4)	12,102	(77.9)	9143	(58.9)	2352	(15.1)	1188	(7.6)	12,052	(77.6)	9060	(58.3)
	Grade level or above	23,200	(45.4)	18,633	(80.3)	12,945	(55.8)	2336	(10.1)	1115	(4.8)	18,600	(80.2)	12,889	(55.6)
	Missing	12,326	(24.1)	7866	(63.8)	6110	(49.6)	1554	(12.6)	801	(6.5)	7840	(63.6)	6068	(49.2)
Below 185% of federal poverty line	No	11,185	(21.9)	8413	(75.2)	5613	(50.2)	981	(8.8)	465	(4.2)	8399	(75.1)	5593	(50.0)
	Yes	37,335	(73.1)	28,436	(76.2)	21,196	(56.8)	4924	(13.2)	2462	(6.6)	28,345	(75.9)	21,043	(56.4)
	Missing	2539	(5.0)	1725	(67.9)	1389	(54.7)	337	(13.3)	177	(7.0)	1748	(68.8)	1381	(54.4)
Parental education	Less than high school	3007	(5.9)	2244	(74.6)	1719	(57.2)	278	(9.2)	146	(4.9)	2235	(74.3)	1708	(56.8)
	High school graduate	20,828	(40.8)	16,386	(78.7)	12,492	(60.0)	3039	(14.6)	1504	(7.2)	16,331	(78.4)	12,407	(59.6)
	Some education after high school	4688	(9.2)	3755	(80.1)	2791	(59.5)	657	(14.0)	332	(7.1)	3743	(79.8)	2768	(59.0)
	Trade school	3821	(7.5)	3172	(83.0)	2376	(62.2)	576	(15.1)	288	(7.5)	3164	(82.8)	2363	(61.8)
	Junior college	5274	(10.3)	4314	(81.8)	3028	(57.4)	639	(12.1)	317	(6.0)	4307	(81.7)	3020	(57.3)
	4-year college	5773	(11.3)	4579	(79.3)	2990	(51.8)	543	(9.4)	271	(4.7)	4571	(79.2)	2971	(51.5)
	Graduate school	1025	(2.0)	774	(75.5)	486	(47.4)	81	(7.9)	37	(3.6)	774	(75.5)	484	(47.2)
	Missing	6643	(13.0)	3377	(50.8)	2316	(34.9)	429	(6.5)	209	(3.1)	3367	(50.7)	2296	(34.6)
Any school suspension	No	13,834	(27.1)	9622	(69.6)	6231	(45.0)	942	(6.8)	472	(3.4)	9612	(69.5)	6206	(44.9)
	Yes	36,180	(70.9)	28,333	(78.3)	21,453	(59.3)	5172	(14.3)	2563	(7.1)	28,237	(78.0)	21,300	(58.9)
	Missing	1045	(2.0)	646	(61.8)	514	(49.2)	128	(12.2)	69	(6.6)	643	(61.5)	511	(48.9)

Note: All associations between categorical variables were examined for statistical significance using Pearson's Chi-Square tests. All bivariate associations were found to be statistically significant at $p < 0.001$ if missingness is considered, and $p < 0.05$ if missingness is ignored.

compared to their age peers in the general population was 8.9. The risk ratio for gun-involved crime in the firearm-restricted subgroup of 18–24-year-olds in the study population was 17.2.

3.3. Results of analysis 2. Examining trends in arrests and convictions and estimating legal system predictors of gun-involved crime in young adults with a juvenile crime history: categorical regression analysis with mutually exclusive classification of juvenile record status at age 18

In all four status categories, arrests and convictions for non-firearm-related offenses were more common than for firearm-related offenses (Table 2). During the follow-up period, a total of 75.4% of the cohort were arrested and 54.9% were convicted for a non-firearm-involved

offense; 12.2% were arrested and 6.1% convicted for a firearm-related offense as young adults.

As shown in Fig. 1, rates declined with increasing age across all four juvenile record statuses, but followed somewhat different trajectories. Those with a felony conviction in criminal court before age 18 had higher annualized rates of firearm and non-firearm-involved arrests and convictions than those in the other three statuses across all age groups.

The results in Table 3 shows that individuals with only misdemeanor-equivalent juvenile adjudications had the lowest risk of firearm and non-firearm-involved arrests compared with the other groups; individuals with a felony criminal record by age 18 had a significantly higher risk of future arrest for non-firearm-involved offenses (OR = 2.45, [CI = 2.37, 2.54]) and an even higher relative risk for

Table 2
Prevalence of adult criminal outcomes by most serious juvenile record status at age 18 (N = 51,059).

			Criminal outcomes at age 18 and older											
			Any criminal offense				*Any firearm-related offense*				*Non-firearm-related offense only*			
Most serious juvenile record status at age 18	Total sample		Arrest		Conviction		Arrest		Conviction		Arrest		Conviction	
	N	(Pct.)	N	(Pct.)	N	(Pct.)	N	(Pct.)	N	(Pct.)	N	(Pct.)	N	(Pct.)
All statuses combined	51,059	(100.0)	38,601	(75.6)	28,198	(55.2)	6242	(12.2)	3104	(6.1)	38,492	(75.4)	28,017	(54.9)
A. Juvenile adjudication - misdemeanor equivalent	14,442	(28.3)	8422	(58.3)	5494	(38.0)	907	(6.3)	383	(2.7)	8404	(58.2)	5468	(37.9)
B. Juvenile adjudication - felony equivalent	6053	(11.9)	3738	(61.8)	2975	(49.2)	868	(14.3)	418	(6.9)	3724	(61.5)	2962	(48.9)
C. Criminal conviction - misdemeanor	25,707	(50.4)	21,995	(85.6)	15,744	(61.2)	2672	(10.4)	1257	(4.9)	21,965	(85.4)	15,685	(61.0)
D. Criminal conviction -felony (gun-prohibited)	4755	(9.3)	4386	(92.2)	3945	(83.0)	1789	(37.6)	1042	(21.9)	4339	(91.3)	3862	(81.2)
Missing	102	(0.2)	60	(58.8)	40	(39.2)	6	(5.9)	4	(3.9)	60	(58.8)	40	(39.2)

Note: The missing cases were people with unknown legal status before age 18, and could possibly be people with an adult criminal record but without a juvenile record. They were excluded from subsequent analysis.
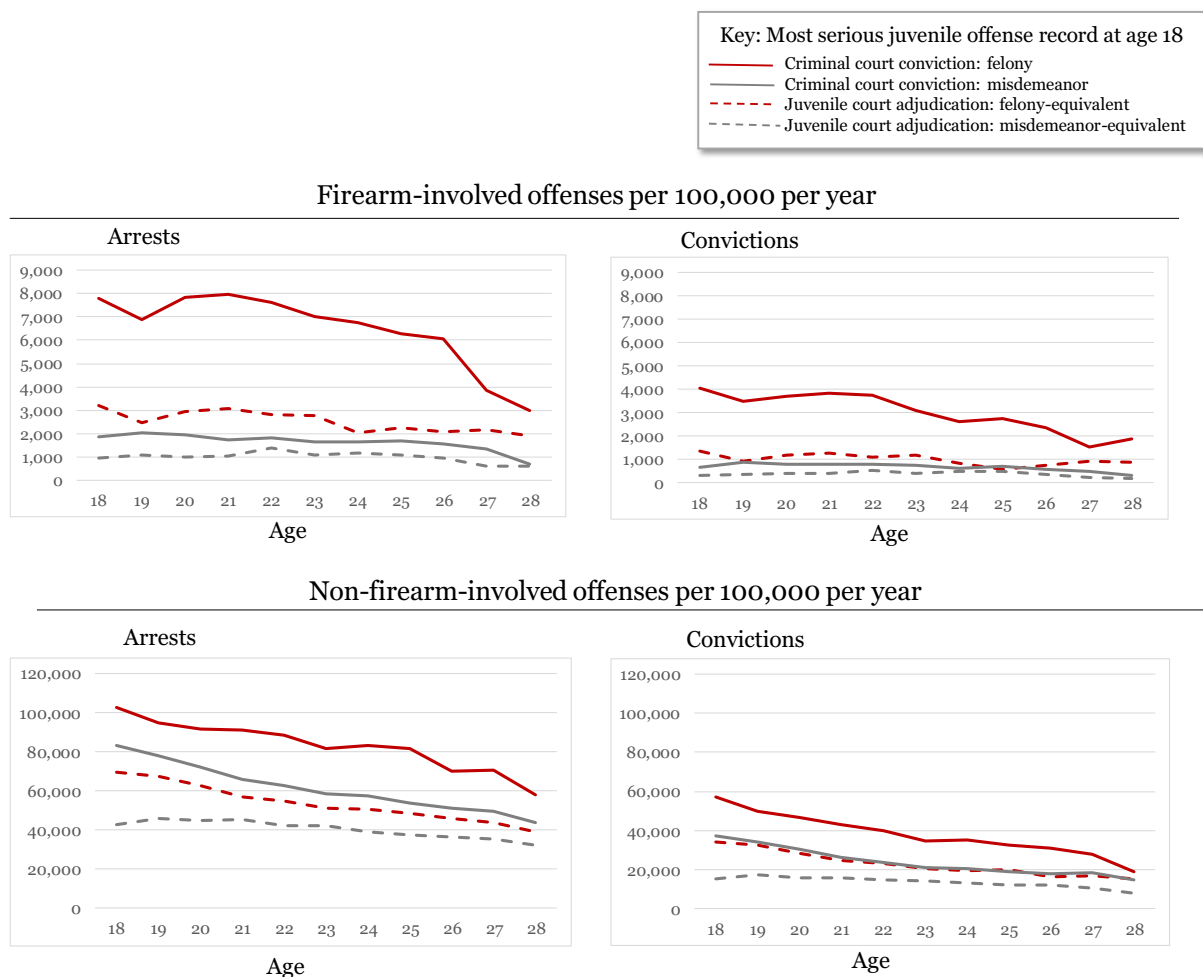
Fig. 1. Age trends in annualized firearm-involved and non-firearm-involved arrest and conviction rates in early adulthood, by most serious juvenile offense record at age 18 (*N* = 51,059).

firearm-involved offenses (OR = 5.14, [CI = 4.71, 5.62]). The highest adjusted odds ratio for being arrested as a young adult for a firearm-involved offense was associated with the subgroup of individuals who not only had a felony criminal conviction as a minor, but also had spent time in prison before reaching age 18 (OR = 5.53, [CI = 4.94, 6.19]). Full results with odds ratios for covariates can be found in Supplement Table 1.

Very similar results were obtained with analogous models specifying criminal convictions as the outcome (see Supplement Tables 2 and 3.)

Table 3
Unadjusted and adjusted associations between adult arrest outcomes and most serious juvenile record status at age 18.

	Arrest outcomes at age 18 and older							
	Non-firearm-involved offense				*Firearm-involved offense*			
	Unadjusted bivariate associations		Adjusted multivariate associations		Unadjusted bivariate associations		Adjusted multivariate associations	
Most serious juvenile record status at age 18	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
A. Juvenile adjudication - misdemeanor equivalent	1.00 [ref.]		1.00 [ref.]		1.00 [ref.]		1.00 [ref.]	
B. Juvenile adjudication - felony equivalent	1.44	(1.38–1.50)	1.35	(1.29–1.40)	1.55	(1.42–1.69)	1.89	(1.70–2.09)
C. Criminal conviction - misdemeanor	1.62	(1.58–1.66)	1.73	(1.68–1.77)	1.68	(1.54–1.83)	1.97	(1.81–2.14)
D. Criminal conviction - felony (gun-prohibited)	2.86	(2.76–2.96)	2.45	(2.37–2.54)	8.63	(7.91–9.42)	5.14	(4.71–5.62)
D1. No prison before 18	2.79	(2.69–2.90)	2.40	(2.31–2.49)	8.18	(7.46–8.98)	5.00	(4.56–5.49)
D2. Prison before 18	3.05	(2.89–3.21)	2.60	(2.46–2.74)	9.95	(8.89–11.15)	5.53	(4.94–6.19)

Note: All models were estimated with repeated measure GEE analysis with exchangeable working correlation. The adjusted analysis includes the following covariates, birth year, sex, race/ethnicity, eighth grade math and reading achievement, parental education, economically disadvantaged, and any school suspension. Missingness in covariates are accounted for using missingness indicators. All odds ratios shown in the table are statistically significant at $p < 0.0001$.

3.4. Results of analysis 3. Estimating the effect of later vs. earlier initiation of juvenile offending on the risk of adult criminal offending, its severity, and the involvement of firearms

Fig. 2 presents the subgroup analysis of associations between age at the time of first felony-equivalent adjudication or criminal conviction and future arrests and convictions for offenses involving firearms and not involving firearms. The effect sizes for each association can be found in Supplement Table 4. Covariate-adjusted analyses show that a youth's older age at the time of first offense can significantly moderate future risks of both firearm-involved and non-firearm-involved arrests and convictions in adulthood.

Considering criminal outcomes involving firearms, young adults who were age 16 when first convicted or adjudicated for a felony-level offense had a significantly lower risk of reoffending than their counterparts who were adjudicated at age 13 (OR = 0.40 [CI = 0.31,0.52] for a future arrest, OR = 0.28 [CI = 0.19,0.41] for a conviction.) The pattern of lower future risk for older initiators was less pronounced for criminal outcomes not involving firearms (OR = 0.63 [CI = 0.56,0.70] for an arrest, OR = 0.56 [CI = 0.49,0.65] for a conviction.) In models comparing outcomes for 15-year-old initiators to 13-year-old initiators, effect sizes were more modest but still statistically significant. Risk of future arrests and convictions did not significantly differ for those with a

first adjudication at age 14 compared to age 13.

4. Discussion

Given the prevalence of firearms in the U.S. and the Supreme Court's broad interpretation of the right to bear arms, risk-based firearm restrictions are an essential policy tool to prevent gun violence. Restrictions (or lack of restrictions) based on a person's age, criminal record, and the combination of these two variables affect a large proportion of the population, vary widely between states, and have not been systematically studied. Research evidence on the risk of firearm-involved crime and other crime in young adults with gun-disqualifying criminal records and not-disqualifying juvenile adjudication records can help to evaluate the rationale for these laws and their limitations as implemented, and highlight opportunities for reform.

This study assembled a dataset of matched, longitudinal criminal arrest and conviction data for a large population of young adults in North Carolina who had acquired a record of a juvenile delinquency adjudication or criminal conviction before reaching age 18 ($N = 51,059$ individuals, 4.9 million person-month observations), in order to describe and compare trends in criminal arrests among those who were legally prohibited from accessing firearms, and not prohibited.

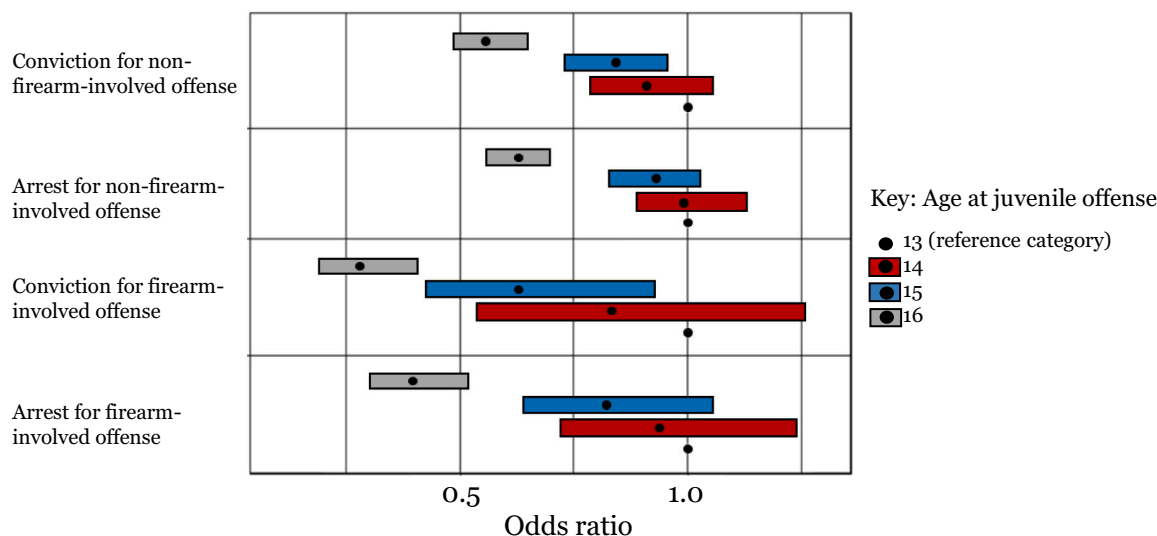Approximately 75% of individuals in our study were rearrested for

Fig. 2. Odds ratios for adult criminal outcomes by age of juvenile offense: testing the early-initiation effect in a subset of juvenile offenders with one offense record from age 13 to 16 ($N = 5754$). Note: Shaded areas in each bar represent 95% confidence intervals around the corresponding odds ratio point estimate. These results are based on covariate adjusted analyses. Adjusted covariates include birth year, sex, race and ethnicity, math and reading achievement, economic disadvantage, parental education, and any suspension in school. Estimate results are included in Supplement Table 4.

some offense by the end of follow up. The large majority of those who committed firearm-related crimes were already legally ineligible to access firearms and would have failed a federal background check to purchase a gun from a licensed dealer; they were able to access guns anyway.

If firearm restrictions are to be based on risk, our finding that felony convictions are strongly associated with increased risk of future offending with a firearm suggests that the felony-based firearm restriction is appropriate. However, as currently implanted in North Carolina, it fails to deter a substantial number of gun-involved crimes. Those who acquired a felony conviction as a juvenile had a risk of future firearm-related arrest 17 times higher than the general population in the same age group, and 5 times higher than other justice-involved individuals who acquired a misdemeanor-equivalent delinquency adjudication record by age 18.

Several factors moderated the elevated risk of firearm-involved crime and other crime in our study population. In general, older first-time felony-equivalent offenders had significantly lower risk of future crime as adults than their younger-initiating counterparts. For example, controlling for relevant covariates and restricting the analysis to people with only one felony adjudication or conviction, young adults who had been adjudicated at age 15 were only about two-thirds as likely to be convicted of a gun-involved crime as those who had been adjudicated at age 13.

Although this pattern could have various explanations, it is consistent with research describing conduct disorder in children, a pattern of repeated rule-breaking behavior that is manifest in 6% to 16% of boys and 2% to 9% of girls in the U.S. population (Jennings et al., 2018). Studies in developmental psychiatric epidemiology have found that children with earlier vs. older-onset conduct disorder are at significantly greater risk for later criminal legal involvement as they grow older (Moffitt, 1993; Offord and Bennett, 1994).

Another significant determinant of crime outcomes in this study population was the severity of their juvenile offending – whether they had been charged with a felony (or equivalent) crime vs. a misdemeanor. Specifically, in a multivariable analysis adjusting for covariates, juvenile offenders who had been prosecuted as adults and convicted of a felony prior to age 18 (and may also have had earlier adjudications in the juvenile justice system) had significantly higher likelihood of arrest and conviction for both firearm-involved and non-firearm-involved offenses, compared with their counterparts who had been found guilty of a misdemeanor in criminal court or adjudicated as a juvenile delinquent for a comparable offense. These individuals had more than double the odds of a non-firearm-involved arrest, and >5 times the odds of firearm-involved arrest. These same adjusted regression analyses showed that individuals with misdemeanor-equivalent delinquency adjudications had the lowest relative odds of future arrest as young adults, both for firearm-involved and non-firearm-involved crimes, when compared to those who had received any criminal convictions or had been adjudicated as a delinquent for a felony-equivalent offense in juvenile court. These findings suggest that risk-based firearm restrictions for young adults with a juvenile arrest history should be focused on those who committed more serious offenses.

The study also found that youth with a felony conviction who were incarcerated prior to age 18 were more likely to experience future arrests and convictions than youth whose early offenses did not result in incarceration. This association could reflect a selection process by which individuals with the greatest concentration of risk factors for future offending were also the most likely to be prosecuted as adults and incarcerated. However, other research would suggest that labeling youth as "dangerous" and confining them to prison or a secure detention facility can become a self-fulfilling prophecy by increasing the risk of future offending (Copeland et al., 2021), especially when they are placed in facilities that deemphasize (or simply lack) rehabilitative programming (Loeffler and Nagin, 2022).

Sanctions that are designed to deter and incapacitate serious offenders –including incarceration and collateral forfeiture of firearm rights – have long been seen as components of crime control policy as well as gun-violence-prevention policy in the U.S. At the same time, it must be acknowledged that prosecuting minors as adults and incarcerating them at an impressionable age and critical stage of life-course development may produce negligible benefits (Loughran et al., 2010; Loughran et al., 2009) while exacting a high human cost both to the affected individuals and to society. Incarcerated young persons are uprooted and isolated from potentially beneficial sources of support and socialization in the community; they may miss opportunities to attain an education, enter the paid labor market, and build personal reputational and social capital. Moreover, the prison environment can compound pre-existing social risk factors such as childhood adversity and poverty (Font and Maguire-Jack, 2020), and further expose immature, traumatized, and vulnerable young persons to psychologically toxic stressors as well as criminogenic influences. Incarcerated youth may then experience alternative socialization to deviant norms, adopt maladaptive coping mechanisms such as substance misuse, and gain access to criminal networks and illegal firearms markets – all of which may tend to reinforce a pattern of antisocial behavior that can persist and solidify.

The study adds further evidence confirming that racial inequality continues to permeate the U.S. criminal justice system. Our study calculated that Black and Latinx youth under age 18 are twice as likely as their white counterparts to become involved with the criminal legal system or the juvenile justice system in North Carolina. Addressing the upstream social risk factors that underlie such disparities in gun violence should be a public health imperative both for researchers and policymakers.

While this study's main focus is gun-related crime, an important secondary finding is that the risk of other crime, too, follows a quite similar pattern associated with age and early offending – and there are far more of these non-gun crimes than there are gun crimes. The question arises, then, should crime prevention policies for a high-risk young adult population focus most attention on preventing the most prevalent types of crimes, which do not involve the misuse of firearms? One answer is that preventing gun crime can have a broad impact in preventing all crime. Previous studies, such as the Rochester Youth Development Study by Lizotte and collaborators (Lizotte et al., 2000; Emmert et al., 2018), have shown that gun carrying dramatically increases participation in all forms of delinquency and crime, and that this pattern persists from adolescence into young adulthood. By implication, preventing gun carrying by high-risk individuals could help to deter a whole spectrum of crimes for which firearms act as a catalyst or an accelerant. Our research suggests that firearm restrictions alone for young adults with serious juvenile crime histories are insufficient to deter adult crime in this high-risk population. But in light of Lizotte's work, our study also bolsters the rationale for having such restrictions and improving their enforcement and implementation, that is, with the hope that preventing gun crime eventually could not only save lives, but have a much larger effect in preventing other, more prevalent types of crime that is precipitated, facilitated, or exacerbated by gun carrying.

In summary, what does our study suggest about the value of state policies that allow vs. deny lawful access to firearms to adults who committed crimes as juveniles? On the one hand, young adults with a juvenile delinquency adjudication but no conviction record in adult criminal court pose a particular challenge for gun violence prevention policy. Their combination of immaturity with an early life history of lawbreaking places them at a persistently high risk of misusing a firearm, yet in many states, like North Carolina, they are not prohibited from purchasing and possessing guns; perhaps they should be prohibited, at least through the early years of adulthood when risk is highest.

A policy of prosecuting minors in adult criminal court for serious offenses – especially for violent crimes involving firearms – might appear to have at least the benefit of prohibiting such individuals from legally accessing firearms when they become adults. On the other hand,

our study's findings from North Carolina suggest that a policy of transferring minors from juvenile court jurisdiction to adult criminal court may have other serious adverse consequences that substantially increase the risk of violent gun crime in these (gun-prohibited) young adults, given their apparently easy access to firearms from sources untouched by the background check system.

Results of this study's analysis will temper and condition expectations for what categorical point-of-sale firearm restrictions targeting former juvenile offenders can accomplish on their own, and instead highlight the urgent need for complementary policies to curtail widespread illegal and other access to firearms and mitigate upstream social and developmental determinants of injurious behavior in vulnerable youth.

4.1. Limitations

The study had several limitations. The information pertains to a single state, North Carolina, and might not be generalizable to other states. The comparison of adult crime outcomes between 15-year-olds who were adjudicated as juvenile delinquents and 16-year-olds who were convicted in criminal court is subject to age bias and does not account for prosecutorial discretion in who gets charged. Coding of firearm involvement in criminal offending was limited to information contained in the description of the charging offense. Incarceration information was limited to state prisons, with no accounting of jail stays. Finally, we not could track offenses that occurred out of state.

5. Conclusion

Gun crime prevention policies and interventions should focus especially on younger offenders who engage in more serious violent offending. Targeted categorical gun restrictions alone are insufficient to deter gun-related crime in these very high-risk populations, given the robust alternative supply of firearms that persons involved in criminal activity can too easily access without undergoing a background check. A focus on upstream social and developmental determinants of youth violence and criminal behavior, comprehensive background checks for firearm purchase, and supply-side policies – strengthening and enforcing laws designed to interrupt illegal firearm markets – is needed in order for age-based restrictions at the point of sale to serve their purpose in helping to curb gun violence in the U.S.

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Declaration of Competing Interest

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

Data availability

The authors do not have permission to share data.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2022.107279.

References

Aizer, A., Doyle, J.J., 2015. Juvenile incarceration, human capital, and future crime: evidence from randomly assigned judges. Q. J. Econ. 130, 759–803.

Basto-Pereira, M., Mirando, A., Ribiero, S., Maia, A., 2016. Growing up with adversity: from juvenile justice involvement to criminal persistence and psychosocial problems in young adulthood. Child Abuse Negl. 62, 63–75.

Bipartisan Safer Communities Act, 2022. Public Law, No, pp. 117–159.

Census Bureau, U.S., 2020. Annual Estimates of the Civilian Population by Single Year of Age and Sex for the United States, States, and the District of Columbia: April 1, 2010 to July 1, 2020. U.S. Census Bureau, Population Division.

Census Bureau, U.S.. Quick Facts, North Carolina.. https://www.census.gov/quickfacts/NC.

Charles, J., 2019. Dangerous, Unvirtuous Felons and the Scope of the Second Amendment. Second Thoughts. Center for Firearms Law at Duke University. https://sites.law.duke.edu/secondthoughts/2019/05/29/dangerous-unvirtuous-felons-and-the-scope-of-the-second-amendment/.

Copeland, W., Tong, G., Gifford, E., Easter, M., Shanahan, L., Swartz, M., Swanson, J., 2021. Adult criminal outcomes of juvenile justice involvement. Psychol. Med. 1-8 https://doi.org/10.1017/S0033291722000393.

Emmert, A.D., Penly Hall, G., Lizotte, A.J., 2018. Do weapons facilitate adolescent delinquency? An examination of weapon carrying and delinquency among adolescents. Crime Delinq. 64 (3), 342–362.

Emmert, et al., 2018. op cit.

Fairchild, G., Hawes, D.J., Frick, P.J., Copeland, W.E., Odgers, C.L., Franke, B., Freitag, C.M., De Brito, S.A., 2019. Conduct disorder. Nat. Rev. 5 (43-1 Reviews).

Federal Bureau of Investigation, 2020a. Crime in the United States 2019, Table 38, Uniform Crime Reporting Program. Department of Justice, Federal Bureau of Investigation, Washington, DC. https://ucr.fbi.gov/crime-in-the-u.s/2019/crime-in-the-u.s.-2019/topic-pages/tables/table-38.

Federal Bureau of Investigation, 2020b. op cit.

Federal Bureau of Investigation, 2020c. op cit.

Font, S.A., Maguire-Jack, K., 2020. It's not "just poverty": educational, social, and economic functioning among young adults exposed to childhood neglect, abuse, and poverty. Child Abuse Negl. 101-104.

Gardner, B.O., Bonnie, R.J., Janes, K., Swanson, J.W., Easter, M.M., 2022. The Legal Effect of a Record Delinquency Adjudication on Firearm Access: A Nationwide Survey of State Statutes (Unpublished manuscript).

Giffords Law Center to Prevent Gun Violence. Minimum Age to Purchase and Possess. https://giffords.org/lawcenter/gun-laws/policy-areas/who-can-have-a-gun/minimum-age/.

Giffords Law Center to Prevent Gun Violence. Who Can Have A Gun: Firearm Prohibitions. https://giffords.org/lawcenter/gun-laws/policy-areas/who-can-have-a-gun/firearm-prohibitions/.

Jennings, W.G., Perez, N.M., Reingle Gonzales, J.M., 2018. Conduct disorder and neighborhood effects. Annu. Rev. Clin. Psychol. 14, 317–341.

Kazemian, L., 2021. Pathways to desistance from crime among juveniles and adults: applications to criminal justice policy and practice. NCJ 301503. In: Desistance From Crime: Implications for Research, Policy, and Practice (Washington, DC: U.S. Department of Justice, National Institute of Justice, 2021), NCJ 301497. National Institute of Justice, Office of Justice Programs, U.S. Department of Justice.

Lizotte, A.J., Krohn, M.D., Howell, J.C., Tobin, K., Howard, G.J., 2000. Factors influencing gun carrying among young urban males over the adolescent-young adult life course. Criminology 38, 811–834.

Loeffler, C.E., Nagin, D.S., 2022. The impact of incarceration on recidivism. Annual Review of Criminology. 5, 133–152.

Loughran, T.A., Mulvey, E.P., Schubert, C.A., Fagan, J., Piquero, A.R., Losoya, S.H., 2009. Estimating a dose-response relationship between length of stay and future recidivism in serious juvenile offenders. Criminology. 47, 699–740.

Loughran, T.A., Mulvey, E.P., Schubert, C.A., Chassin, L.A., Steinberg, L., Piquero, A.R., Fagan, J., Cota-Robles, S., Cauffman, E., Losoya, S., 2010. Differential effects of adult court transfer on juvenile offender recidivism. Law Hum. Behav. 34, 476–488.

MacMillan, R., 2001. Violence and the life course: the consequences of victimization for personal and social development. Annu. Rev. Sociol. 27, 1–22.

Moffitt, T.E., 1993. Adolescence-limited and life-course-persistent antisocial behavior: a developmental taxonomy. Psychol. Rev. 100, 674–701.

North Carolina State Bureau of Investigation, 2021. Crime in North Carolina - 2020: Annual Summary Report of 2020 Uniform Crime Reporting Data. https://ncsbi.gov/services/sbi-statistics/sbi-uniform-crime-reports/2020-Annual-Summary.aspx.

Hockenberry, S., Puzzanchera, C., 2021. Office of Juvenile Justice and Delinquency Prevention. National Center for Juvenile Justice, Pittsburgh, PA, pp. 1–102. https://www.ojjdp.gov/ojstatbb/njcda/pdf/jcs2019.pdf.

Office of the Surgeon General (US); National Center for Injury Prevention and Control (US); National Institute of Mental Health (US); Center for Mental Health Services (US). Youth Violence: A Report of the Surgeon General. Rockville (MD): Office of the Surgeon General (US), 2001. Chapter 4 – Risk Factors for Youth Violence. Available from: https://www.ncbi.nlm.nih.gov/books/NBK44293/.

Offord, D.R., Bennett, K.J., 1994. Conduct disorder: long-term outcomes and intervention effectiveness. J. Am. Acad. Child Adolesc. Psychiatry 33, 1069–1078.

Pierce, G.L., Braga, A.A., Hayatt Jr., R.R., Koper, C.S., 2006. Characteristics and dynamics of illegal firearms markets: implications for a supply-side enforcement strategy. Justice Q. 21, 391–422.

Scialabba, N., 2016. Should juveniles be charged as adults in the criminal justice system? Results of "tough on crime" policies demonstrate that they have failed. American Bar Association. https://www.americanbar.org/groups/litigation/committees/childrens-rights/articles/2016/should-juveniles-be-charged-as-adults/.

Song, M., Zhou, X., Pazaris, M., Spiegelman, D., 2021. The Missing Covariate Indicator Method is Nearly Valid Almost Always. https://arxiv.org/abs/2111.00138.

Stolzenberg, L., D'Alessio, S.J., Flexon, J.L., 2021. The usual suspects: prior criminal record and the probability of arrest. Police Q. 24, 31–45.

Tong, G., Li, F., Allen, A.S., 2020. Missing data. In: Piantadosi, S., Meinert, C. (Eds.), Principles and Practice of Clinical Trials. Springer, Cham, pp. 1–21.

USA. Gun Control Act of 1968, 1968. Public Law 90e618, Title 18, United States Code - Firearms; Chapter 44 (Section 101). Congress of the United States, Washington DC.