



Intergenerational social mobility and suicide risk by firearm and other means in US males

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ABSTRACT

Firearms are the leading method of suicide in US men, and socioeconomic status (SES) is associated with suicide risk. In this 40-year mortality follow-up of a national cohort of US men, we examined if improved SES relative to one's family of origin, upward *intergenerational social mobility* (ISM), is associated with lowered risk for firearm suicide and suicide by other means in US men. Family of origin SES was assessed as part of Project Talent, a broad survey of US high school students in 1960. 42,766 men in the cohort completed follow-up surveys at age 29, assessing attained SES via education, occupation, and income. ISM was measured by change between harmonized SES composites. Mortality follow-up was conducted through age 70. Adjusting for baseline SES and race/ethnicity, a 1 standard deviation increase in SES was associated with a 31% reduction in firearm suicide risk later in the life course (HR [95% CI] = 0.69 [0.54, 0.88], $P = 0.003$), and a smaller, non-significant reduction in suicide by other means (HR [95% CI] = 0.80 [0.60, 1.07], $P = 0.136$). Traits associated with both suicide and SES attainment (cognitive ability, calm, impulsivity) only modestly attenuated this association. Upward ISM was more strongly associated with reduced firearm suicide risk in males with parents of low SES. The association between upward ISM and reduced firearm suicide mortality risk prevailed over ensuing decades. Policies improving social mobility in US males, particularly those of lower SES, may function as de-facto firearm suicide prevention strategies.

1. Introduction

Suicide rates in the United States (US) increased by an alarming 35.2% over two decades before decreasing 2.1% in 2019 (Hedegaard et al., 2021) and by another 3% in 2020 based on near complete data (Curtin et al., 2021). Of the 47,511 suicide deaths in the US in 2019, 50.4% were by firearm, with 86.6% of firearm suicides carried out by males (National Center for Injury Prevention and Control, 2020). Moreover, there was a 19% increase in the age-adjusted firearm suicide rate among US males between 2006 and 2019 (Hedegaard et al., 2021). Firearms are also the most lethal method of self-harm (Conner et al., 2019) and the acquisition of a firearm, particularly a handgun, is a potent risk factor for suicide (Studdert et al., 2020). The prevalent use of deadly firearms in suicide in males is unique to the US and requires dedicated efforts to understand and mitigate risk.

As with many health outcomes, suicide highlights social inequalities: individuals of lower socioeconomic status (SES) are at increased risk for suicide (Iemmi et al., 2016; Kposowa, 2001; Lorant et al., 2005). Indeed, a meta-analysis of individual-level studies concluded that as many or more suicides in the general population are “attributable” to SES indicators of low occupational status and low education as they are to mental health disorders such as mood- or substance use disorders (Li et al., 2011). Most of the evidence for links between lower SES and suicide risk is based on studies of males (Richardson et al., 2021) or of samples of mixed gender that generally show stronger associations of SES and suicide in males than females (Li et al., 2011). The stereotypic role of educational and occupational achievement, and of breadwinning, in the socialization and self-esteem of males (Twenge and Campbell, 2002) may help to explain the large links between SES and men's suicide risk. However, research thus far has been dominated by studies using

Abbreviations: SES, Socioeconomic status.

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single static measurements of SES (Iemmi et al., 2016; Kposowa, 2001; Lorant et al., 2005). Thus, it is unclear if movement up or down the SES ladder—social mobility—can alter SES-based suicide risk. If so, social policy aimed at enhancing social mobility could have key implications for suicide prevention at the population level.

SES and social mobility may be particularly important for firearm suicide risk among US men. Men who conform to stereotypical masculine norms, including the “breadwinner” role, are more likely to own a firearm in the US (McDermott et al., 2021). Thus, the same men particularly sensitive to declines in SES have greater access to firearms. Firearm suicide decedents are also less likely to have histories of treatment for mental disorder than individuals who carry out suicide by other methods (Stone et al., 2018). Accordingly, models of suicide emphasizing mental illness that are largely based on high-risk clinical populations may be of questionable generalizability to firearm suicide, necessitating a focus on SES, social mobility, and other social determinants that are salient in the everyday lives of the general population of men.

We examined the prospective association between intergenerational social mobility (ISM) and suicide in Project Talent men, a population cohort of US youth assessed in high school, again at age 29, then followed-up for mortality through age 70. ISM reflects the difference between one’s family of origin SES and one’s own adult SES. A complicating factor is that traits such as cognitive ability, neuroticism, and impulsivity predict both suicide risk (Batty et al., 2018; Conner et al., 2001; Peters et al., 2018) and adult SES attainment (Borghans et al., 2008). Therefore, we examined whether these traits accounted for any observed association between ISM and later suicide. If so, social policies promoting upward social mobility may require targeting or tailoring for young adults with these particular vulnerabilities. Finally, we examined whether associations between ISM and later suicide differed by initial levels of SES in families of origin.

2. Methods

2.1. Design

Project Talent began in 1960 as a national probability sample of 5% of all US high schools ($n = 1,226$). All students enrolled in 9th through 12th grades in selected high schools ($n = 377,016$) completed a comprehensive battery of tests and questionnaires assessing multiple factors, including cognitive aptitude and abilities, academic achievement, interests and hobbies, and home life. Most students ranged in age from 13 to 18 years. A follow-up survey conducted 11 years after each grade cohort graduated captured approximately one quarter of the initial sample at a uniform age of 29 ($n = 94,034$). This follow-up included a special sample of initial non-respondents to render the follow-up more like the initial baseline probability sample (McLaughlin et al., 1979). Henceforth, we refer to this 11-year follow-up as the “age 29” follow-up.

For the current analysis, Project Talent age 29 sample members were followed through 2018 to assess mortality status from 1979 to 2018. Participants were originally tracked using commercial databases, such as LexisNexis, health record data from the Centers for Medicare and Medicaid, and a variety of web resources, like [Ancestry.com](#). Participants identified as deceased in any of these sources were linked with death record data from the National Death Index (NDI) to determine cause of death. All linked records were subjected to an algorithm to automatically review the quality of the linked record. Algorithmic parameters included NDI status code, classification group, probabilistic score, and agreement between identifiers. Linked records were given a score of “true,” “false,” or “questionable.” Records flagged as questionable underwent further investigation by team members who manually reviewed the Project Talent data and NDI death record data to determine if the linkage was true or false. To attain a uniform follow-up age, we analyzed all deaths through age 70.

2.2. Measurements

SES. In high school, participants were asked about parents’ education, occupation, and income, with questions about their own education, occupation and income at age 29 follow-up. For both time points, education was classified as follows: high school drop-out, high school graduate, some non-college post high school education, some college, college graduate, master’s degree, work beyond master’s degree but no doctorate, and doctorate; age 29 follow-up also included a category for “some work beyond master’s degree but no PhD”, which was assigned an intermediate value between the two adjacent categories. Family of origin income in 1960 included five categories: 0–\$2,999, \$3,000–\$5,999, \$6,000–\$8,999, \$9,000–\$11,999 and \$12,000+. At the age 29 follow-up, a specific income number was reported. For comparability, these numbers were inflation adjusted and coded to the same ordinal categories. Parental occupation at 1960 baseline spanned 49 different US Census jobs categories (e.g., clerical worker) or specific professional jobs (e.g., accountant), and respondents’ own occupation at age 29 included 867 specific jobs (general categories were expanded to specific jobs). The most recent job was utilized at both time points if a respondent’s parent was unemployed in 1960 or they were unemployed at the age 29 follow-up. Occupational prestige was scored using Siegel’s system, which reflects public esteem for different jobs based on surveys conducted in the 1960s (Siegel, 1971). The highest of mother or father education and occupational prestige was used for 1960 family of origin SES, or the only one available if the family of origin was a single parent household.

Family of origin and age 29 composite SES scores were estimated from a two factor model using education, occupational status, and income as indicators for SES factors at each time point, constraining factor loadings and variances to equality to establish factorial invariance. This procedure ensures that the SES deposit is defined comparably at both time points. Education and income ordinal categories were modeled with ordinal probit specifications, while occupational prestige scores were modeled with a linear specification. Both composites were Z-scored and showed a correlation of 0.66. Social mobility was defined as a residualized change score for age 29 SES versus family of origin SES. The social mobility score therefore reflects the SD move in SES from family of origin to age 29, given one’s location in the family of origin SES distribution. Analyses with a latent difference score produced nearly identical results for social mobility, and the residualized change and latent difference scores were correlated at 0.91. The advantage of using the residualized change score is that it tends to show slightly greater variation and is uncorrelated with the baseline SES score.

Suicide Mortality. Deaths were coded as suicide if their underlying cause corresponded to ICD-9 (Pre-1998) codes of 950-XX–959-XX, and ICD-10 codes of X60–84, Y87-0. Firearm related suicides were defined based on codes 955, 955-4 and X72–X74. These deaths represent suicide codes for which intent is clear. Accidental poisonings or other deaths with unclear intent were not coded as suicides.

Covariates. Personality was measured at baseline by the Project Talent Personality Inventory (PTPI), which was modeled after personality inventories of the time and has since been mapped to the Five Factor Model traits of Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness (Pozzebon et al., 2013). High scores on the scale “Calm” show the strongest inverse association with Neuroticism (Pozzebon et al., 2013), with low scorers on the Calm scale scoring highly on Neuroticism. Therefore we selected the inverse of calm to represent Neuroticism. The PTPI also includes a scale directly measuring impulsivity (Pozzebon et al., 2013). Cognitive ability was measured by a composite of three tests (reading comprehension, abstract reasoning, basic math) all of which show strong loadings on a higher order “g” factor for general cognitive ability (Major et al., 2012). Each of these scales was standardized within males to Z-scores (mean = 0, SD = 1). An indicator variable for minority race/ethnicity was also included as a covariate.

2.3. Analysis

Analyses implemented Weibull multi-state models (Crowther and Lambert, 2017) with attained age as the time scale (Kom et al., 1997), in transitions states that included firearm suicide, non-firearm suicide, and non-suicide mortality. The latter was included to handle competing risk censoring, while non-firearm suicide mortality provides a critical auxiliary category to determine if any observed associations were unique to firearm suicide (versus suicide regardless of method). The first model estimated the hazard ratio for intergenerational social mobility (a 1 unit change reflecting a 1 SD increase from family of origin SES), including minority race/ethnicity and family of origin SES (scaled in SD units) as covariates. A second model added cognitive ability, calm, and impulsivity and examined the change in the coefficients for social mobility. A final model examined interactions between social mobility and baseline SES with a product term. All models were screened for non-linearity in the log-hazard and non-proportionality (i.e., changing hazards over the attained age time scale). The study was approved by all involved Institutional Review Boards.

3. Results

Table 1 shows descriptive statistics for survivors, firearm suicide decedents, and non-firearm suicide decedents. There was a total of 206 suicide deaths (127 firearm, 79 non-firearm) over 2,231,239 person-years of follow-up, along with 6,031 deaths by other causes (not shown). Suicides were distributed relatively evenly throughout the years of follow-up, with slight peaks during the 40s and 60s. Social mobility scores were approximately symmetrically distributed around zero; about half the sample remained within ± 1 SD of their family of origin SES by age 29 and about 80% remained within ± 1 SD. Upward movement in social mobility by age 29 was associated with higher levels of adolescent cognitive ability and calm (the latter conceptualized as lower neuroticism), and lower levels of adolescent impulsivity (analyses not shown).

Table 2 shows the results for main models examining risk for firearm suicide and non-firearm suicide, respectively. A one SD increase in SES by age 29 was associated with a 31% reduction in firearm suicide later in life (HR [95% CI] = 0.69 [0.54, 0.88], $P = 0.003$). Fig. 1 shows the hazard ratio for SES across the spectrum of intergenerational SES movement. Since social mobility is centered on zero (i.e., attain the same adult SES as one's family of origin), the figure also highlights the elevated risk for firearm suicide among men suffering downward social mobility. In Model 2 examining firearm suicide risk, adjusting for adolescent traits, upward social mobility reduced risk by 22%, an attenuation of approximately one third (HR [95% CI] = 0.78 [0.60, 1.01], $P = 0.062$), and non-significant though within the 95% CI of the original estimate. The attenuation appeared due primarily to adolescent cognitive ability.

The right portion of Table 2 shows the results for non-firearm suicide mortality. Upward social mobility was associated with a smaller, non-significant reduction in non-firearm suicide risk (HR [95% CI] = 0.80 [0.60, 1.07], $P = 0.136$). Interactions between social mobility and family of origin SES were not significant for either firearm suicide ($P = 0.10$) or non-firearm suicide ($P = 0.15$). Higher family of origin SES, upward social mobility, and white race/ethnicity were all associated with lower risk of non-suicide mortality (analyses not shown). Analyses collapsing firearm suicide and non-firearm suicide risk into a single male suicide category revealed a significant reduction in risk associated with upward social mobility (HR [95% CI] = 0.73 [0.61, 0.87], $P = 0.001$) which was again modestly attenuated by adolescent traits (HR [95% CI] = 0.80 [0.65, 0.98], $P = 0.032$).

4. Discussion

Our analysis of a large national sample of US males assessed in high

Table 1

Project Talent male follow-up sample descriptive statistics.

	Survivors Through Age 70 N = 36,529	Firearm Suicide Decedents N = 127	Non-Firearm Suicide Decedents N = 79
Family of Origin Income Bracket			
Very Low	6.3%	8.6%	3.5%
Low	29.5%	32.2%	17.2%
Average	32.7%	35.4%	41.4%
High	16.3%	10.8%	24.1%
Very High	15.3%	12.9%	13.8%
Age 29 Attained Income Bracket			
Very Low	13.5%	16%	22.3%
Low	16.4%	16%	17.1%
Average	38.3%	39.2%	29%
High	20.8%	18.4%	14.5%
Very High	10.5%	10.4%	17.1%
Parental Education (Highest of Mother and Father)			
< Bachelor's Degree	71.8%	74%	64.1%
Bachelor's Degree	9.2%	12.2%	11.5%
> Bachelor's Degree	19%	13.8%	24.4%
Age 29 Attained Education			
< Bachelor's Degree	55.3%	71.4%	58.1%
Bachelor's Degree	15.8%	8.4%	18.9%
> Bachelor's Degree	28.9%	20.2%	23%
Parental Occupational Prestige (Highest of Mother and Father)			
	49.9 (11.1)	49.2 (9.8)	50.7 (11.4)
Age 29 Attained Occupational Prestige			
	47.3 (15.3)	44.9 (15.9)	44.3 (20.1)
Baseline SES and ISM Composites			
Family of Origin SES Z-score	-.02 (1.00)	-.13 (.95)	-.22 (1.05)
Social Mobility Score	-.03 (-.786)	-.18 (-.71)	-.11 (-.80)
Covariates			
Minority Race/Ethnicity	4.3%	3.1%	3.8%
Adolescent Calm Z-score	-.02 (1)	-.07 (-.97)	-.08 (-.94)
Adolescent Impulsivity Z-score	-.01 (-.99)	-.05 (1.08)	-.05 (1.02)
Adolescent IQ Z-score	-.04 (-.98)	-.25 (1.08)	0 (-.96)

Note: Mean (standard deviation) values, except for minority race/ethnicity. All variables standardized within PT male follow-up participants. Social mobility score = residualized change score for Age 29 versus family of origin SES. Income brackets, based on 1960 income levels and inflation adjusted to 1972: Very Low: 0–\$2,999; Low: \$3,000–\$5,999; Average: \$6,000–\$8,999; High: \$9,000–\$11,999; and Very High: \$12,000+. Less than bachelor's degree educational categories include high school drop-out, high school graduate, some non-college post high school education, some college. Greater than bachelor's degree categories include some graduate courses, master's degree, some work beyond master's and doctorate.

school, again in their late twenties, and followed for mortality through age 70, indicates upward ISM by men's late twenties is associated with decreased suicide risk over most of the adult life course. Importantly, analysis of the results stratified by firearm and non-firearm suicide showed that the protective effects of upward ISM were more strongly observed with suicide by firearm. Specifically, men who achieved a higher level of SES than their parents by their late twenties saw a reduction in firearm suicide risk, while those who declined relative to their parents saw increased risk. Firearm ownership in the US is higher among individuals without a college education, an indication of lower SES (Parker et al., 2017). This is consistent with the present finding that downward social mobility seems more strongly associated with suicide by firearm than by other means; men who slide down the socioeconomic spectrum by their late twenties appear to have greater risk for firearm suicide.

Results also indicated that individual traits associated with both suicide and socioeconomic attainment explain approximately one third

Table 2

Hazard ratios for firearm and non-firearm suicide mortality through age 70.

	Firearm Suicide				Non-Firearm Suicide			
	Model 1		Model 2		Model 1		Model 2	
	HR(95% CI)	P	HR(95% CI)	P	HR(95% CI)	P	HR(95% CI)	P
Minority Race/Ethnicity	.64(-.23, 1.73)	.373	.54(-.19, 1.48)	.230	.91(-.29, 2.89)	.868	.87(-.27, 2.85)	.823
Family of Origin SES Z-score	.84(-.68, 1.03)	.094	.90(-.72, 1.12)	.361	1.26(-.98, 1.61)	.071	1.29(-.99, 1.69)	.061
SES Change at age 29, SD units	.69(-.54, .88)	.003	.78(-.60, 1.01)	.062	.80(-.60, 1.07)	.136	.83(-.60, 1.15)	.265
Adolescent Calm Z-score			.99(-.82, 1.19)	.890			.90(-.71, 1.13)	.360
Adolescent Impulsivity Z-score			1.06(-.89, 1.27)	.497			1.05(-.84, 1.30)	.675
Adolescent IQ Z-score			.82(-.67, 1.01)	.058			.97(-.74, 1.26)	.817

Note: HR = Hazard ratio, 95% CI = 95% Confidence intervals. Multistate Weibull models with firearm suicide, non-firearm suicide, and non-suicide mortality (not shown) as transition states and attained age as time scale. Social mobility is residualized change score between harmonized age 29 SES and family of origin SES composites.

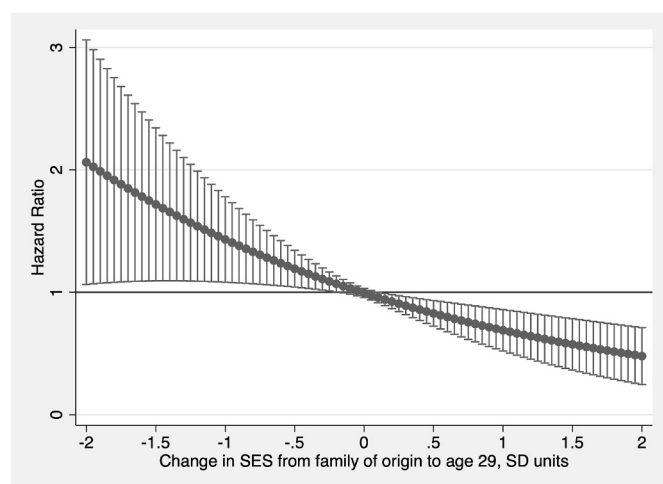


Fig. 1. Relative Risk for Firearm Suicide in US Men Through Age 70 by Intergenerational Social Mobility.

Fig. 1 Caption: Results from multistate survival with attained age as time scale, non-firearm suicide and non-suicide mortality as alternative transition states, and controlling for family of origin SES and race/ethnicity.

of the risk reduction for later firearm suicide among US men moving upward in SES. This risk reduction appeared due primarily to adolescent cognitive ability, a finding previously reported in European samples (Batty et al., 2018). Cognitive ability is also a well-known predictor of later SES attainment (Borghans et al., 2008), reflecting the idea that those of greater cognitive aptitude are more likely to achieve higher levels of education, better paying careers, and accumulate more wealth. In fully adjusted models however, adolescent cognitive ability retained a large though non-significant protective association with later firearm suicide. In totality, this pattern of results suggests that cognitive aptitude in adolescence and upward social mobility in adulthood are related, but retain some distinction as etiologic factors for male firearm suicide.

Some have argued that upward social mobility has been diminishing in the US for several decades (Chetty et al., 2017), and data indicate that the US ranks low among developed countries in social mobility (Causa and Johansson, 2010). In the current data, large increases in firearm suicide risk were noted for those who slid down the socioeconomic ladder, relative to their family of origin. To the extent that upward social mobility becomes increasingly difficult and the chance of sliding downward more probable in the US (Chetty et al., 2017), it lowers the prospects for reversing longstanding trends in male suicide (Hedegaard et al., 2021). Suicide prevention efforts tend to be fixated on an observable and common list of risk factors focused on an individual's current state (e.g., depressed, intoxicated) or recent experiences (e.g., break-up in a relationship, arrest). Approaches to social inequalities in mental health also tend to emphasize current or static assessments of

SES. The current findings argue for a broader life course perspective on suicide prevention that includes upward mobility or downward drift in social-economic status from one's origins.

There are limitations of the study. We focused on males because approximately 86.6% of firearm suicide deaths are males (National Center for Injury Prevention and Control, 2020) and because social mobility appears to have different psychological and health antecedents and consequents in women, and gender differences may be more pronounced in women who grew up and reached adulthood during an era when stereotypic gender roles were more rigid. Nonetheless, availability of a firearm is a potent risk factor for suicide in women including when a handgun is purchased by another household member (Miller et al., 2022). Therefore suicide in women, including firearm suicide, is a topic of major public health significance and deserving of dedicated work. Gender roles and occupational choices also change significantly over time, meaning SES-suicide associations in women vary across birth cohort; this should also be considered in future work with women. The sample, both due to the age cohort and response/attrition, includes a lower proportion of minorities than the current US population. Further work on these issues in minority men is needed. Results are also specific to the US context as other countries differ in suicide rate and factors such as the availability of firearms, as well as social structure and levels of social mobility across generations. Although there is minimal concern about misclassification of death with suicide by firearm, some other methods are more vulnerable to misclassification, particularly intentional self-poisoning. Additionally, we did not adjust our SES composite at either time point for family size or composition. This represents a source of unobserved heterogeneity in measurement, and as such adds error to our estimates of SES and social mobility. We also note that absolute levels of SES in participants at age 29 may not be comparable to those of their parents, measured at baseline, because many parents would be older than 29 and may have accumulated more wealth. However, this would not systematically bias results because all participants' scores reflect their SES at age 29 (rather than a range of possible ages, which could confound SES with age). Moreover, we focused on *intergenerational* social mobility, rather *intragenerational* social mobility, or changes in SES across an individual's adulthood. This too is an important form of change in SES, and bears further investigation. Major life events or more fine grained changes in SES between the two measurements were also not assessed in this study. Events such as a major job loss or downward career move may have important implications for men's suicide risk. We did not track geographic location of participants between high school and age 29, which may be tied to both socioeconomic mobility and firearm laws.

Against these limitations stand several strengths of the current study. Several large and informative, prospective cohort studies conducted in Europe and Canada have examined risk for suicide in men associated with various measures of SES, cognitive ability, and personality constructs, but the generalizability of these studies to the unique context of firearm suicide risk in US men is unclear. In the US, the Project Talent

cohort is based on a representative sample of US high schools, underscoring the relevance of the results to its generational cohort. The follow-up period extended to age 70, spanning a period in the life course when approximately two-thirds of suicides among US men occur (National Center for Injury Prevention and Control, 2020). Indeed, to our knowledge, the follow-up period covered the largest portion of the life course yet for a linked cohort study of suicide in the US featuring detailed self-report research measures, and involved a detailed and multi-layered approach to vital status assessment. We used a rigorous composite of SES harmonized across time period, rather than relying on single indicators, and were able to assess the important confounding roles of individual traits including cognitive ability and personality measures linked to both social mobility and suicide in men.

Firearms are the dominant method of suicide among US males. A parallel is the widespread use of pesticides in suicide in many low- and middle-income countries (Rowhani-Rahbar et al., 2016). This situation has led to legislation banning highly hazardous pesticides in select countries (e.g., Sri Lanka) that have produced dramatic reductions in suicide rates (Rowhani-Rahbar et al., 2016). Therefore, firearm legislation may be expected to be more limited in scope. For example, calls for bans on assault weapons stemming from well-publicized mass shootings, if enacted, may have pronounced public health benefits but seem unlikely to affect rates of suicide that are rarely carried out with such weapons. Alternatively, other targeted legislative initiatives are likely to have greater effect in reducing firearm risk per se, for example instituting waiting periods on the purchase of handguns or other firearms, a strategy to prevent purchase during individual crisis periods when risk is acute, among other benefits. Extreme risk protection orders represent another form of law that may prevent firearm suicide in men. Such legal avenues require the identification of at-risk individuals however, limiting their effects on suicide rates at the societal level. There is also the potential for negative unintended consequences (Keyes et al., 2019). Effects of these types of legislative initiatives require further study.

Initiatives to promote safe storage of firearms are another potential prevention method, with some supportive epidemiologic evidence (Rowhani-Rahbar et al., 2016). However, safe storage initiatives may be of limited benefit in reducing suicide rates at the population level (Yip et al., 2012), although more research is needed on this question. Taking a more universal approach, findings herein point toward the need for a greater understanding of the potential public health burden of suicide and firearm suicide per se among policy makers crafting initiatives that promote social mobility in US males, particularly those of lower SES. Broad-based policies that promote upward mobility from one's origins, especially among males of lower cognitive ability, are needed. Such policies span early childhood through young adulthood and include early intervention programs for children from families who have low SES, college preparedness programs, and financial assistance for first-generation college students (Causa and Johansson, 2010). We do not view such policy initiatives as a panacea or as a substitute for firearm legislation but, nonetheless, they may play a vital role at the societal level in addressing firearm suicide risk over the life course among males in the US.

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Declaration of competing interest

None to declare.

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