

Adolescent Predictors of Firearm Suicide Over Four Decades of Life in U.S. Men



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Introduction: There are meager individual-level data on long-term predictors of firearm suicide.

Methods: This was an analysis of males (N=189,558) in the Project Talent cohort, a national probability sample of high school schools in 1960 when students completed a baseline Project Talent self-report inventory. Mortality follow-up was contingent on survival until 1979, the onset of the National Death Index when the cohort had a mean age of 35.7 years. Mortality follow-up continued until death or age 75 years, reached by all surviving members by 2018. Analyses were conducted in 2022, with the main outcome being firearm suicide deaths ($n=479$). Factor analyses of Project Talent items yielded three key factors: (1) interests in firearm-related professions (i.e., military service, police force), (2) interests in hunting or fishing and knowledge of long guns, and (3) stereotypic masculinity.

Results: Survival analyses showed that long-term risk for firearm suicide was associated with 1-SD increases in firearm-related vocational interests in adolescence (adjusted hazard ratio [95% CI] =1.23 [1.09, 1.40]) and masculinity (adjusted hazard ratio [95% CI]=1.15 [1.04, 1.28]). Decreased long-term firearm suicide risk was associated with increased hunting interests and knowledge of long guns in adolescence (adjusted hazard ratio [95% CI]=0.86 [0.77, 0.96]) and competitive sports participation, an exploratory variable (adjusted hazard ratio [95% CI]=0.89 [0.80, 0.99]).

Conclusions: Prevention efforts are needed to lower long-term firearm suicide risk among adolescent males with high stereotypic masculinity and those interested in military or police service. Potential protective effects of competitive sports participation and socialization to long guns through hunting require further study.

Am J Prev Med 2024;66(4):690–697. © 2023 American Journal of Preventive Medicine. Published by Elsevier Inc. All rights reserved.

INTRODUCTION

After modest drops in suicide rates during the coronavirus disease 2019 (COVID-19) pandemic, the suicide rate in the U.S. rose sharply in 2021, reaching an all-time high.¹ The increased rate is a continuation of a longstanding trend, with rates increasing by more than one third since 2000, with greater increases in select populations, including Black male youth.^{2,3} Approximately 78% of suicide decedents are males, 58% use a firearm, and males account for 87% of all firearm suicide deaths,¹ underscoring the importance of research and prevention of firearm suicide in U.S. males. Indeed,

firearms are the most deadly method of self-harm⁴; firearm suicide risk is higher in demographic groups with high firearm ownership (e.g., rural men),⁵ and access to a firearm, particularly a handgun, is a potent risk factor.⁶

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0749-3797/\$36.00

<https://doi.org/10.1016/j.amepre.2023.11.006>

A life course perspective stresses the importance of examining earlier periods of life to ascertain their downstream effects on health outcomes,⁷ with adolescence being viewed as a key period for health outcomes far into the future,⁸ including suicide.⁹ In this study, the long-term risk for firearm suicide associated with firearm-related socialization in adolescent males was examined. *Firearm-related socialization* is defined as the process of acquiring values, behaviors, and attitudes related to firearm ownership and use. There has been illuminating ecological-level firearm-related socialization research,^{10,11} but there is a lack of individual-level studies linking firearm-related socialization in adolescence with firearm injury deaths in adulthood, the gap addressed in this study.

Social cognitive theory posits that behaviors and attitudes are learned vicariously through observation, modeling, and reinforcement of behavior (approval, praise, punishment), including through media.¹² Adolescents' identification with their parents and peers; inclinations for status, affection, and avoidance of rejection; and exposure to a behavior or attitude serve to make it more attractive.¹³ Research on adolescents shows that personal experience with firearms (e.g., hunting), household ownership of firearms, peer use of firearms, and positive family and peer attitudes toward firearms influence personal attitudes toward firearms and inclinations toward their ownership and use.^{10,14} Some research also reports associations of suicidal thoughts and behavior in adults with access to a gun in childhood¹⁵ and prior experience firing a gun.¹⁶

Socialization and learning are influenced by personality characteristics present in adolescence, for example, neuroticism or its opposite, calm, which can also influence long-term health behaviors and outcomes, including all-cause mortality.¹⁷ However, limited data exist on personality variables measured in youth and long-term risk for suicide. In the study of firearm suicide, personality features associated with firearm interests and ownership warrant special attention, including stereotypic masculinity.¹⁸ One report showed that stereotypic masculinity measured in adolescence was associated with prospective risk for suicide deaths in U.S. males.¹⁹ All but one of the suicide deaths were carried out with a firearm, suggesting a link between masculinity and risk for firearm suicide per se, but the small number of suicide deaths in the cohort ($n=22$) makes this idea speculative. In contrast, a report of Swedish military conscripts showed that lower stereotypic masculinity increased the risk for suicide,²⁰ but the analyses did not examine firearm suicide per se, and generalizability to the U.S. is unclear.

A large cohort of U.S. males who were first examined in high school were linked with mortality records over 4

decades in the life course.⁹ The primary objective of the analysis was to test the hypothesis that firearm-related socialization in adolescence, consisting of contextual variables that indicate exposure to firearms (e.g., practical knowledge about firearms) and that signal an adolescent's interest in firearm-related vocations (e.g., desire to enlist in armed forces), confers long-term risk for firearm suicide in U.S. males. The secondary objective was to test the hypothesis that stereotypic masculinity in adolescence confers long-term risk for firearm suicide.

METHODS

Study Population

Project Talent (PT) began in 1960 as a national probability sample of 5% of all U.S. high schools ($n=1,226$). All 9th- to 12th-grade students ($n=377,016$) in these schools completed a range of tests and questionnaires on cognitive skills, academic achievement, hobbies and interests, and personal and family life. The current analysis is restricted to males in the cohort ($N=189,558$). Specifically, males in PT were followed beginning in 1979, coinciding with the onset of the National Death Index (NDI), when the cohort had a mean (SD) age of 35.7 (1.3) years. Males in PT were followed until age 75 years when the data were censored, with all surviving cohort members reaching age 75 years by the end of 2018. For ease of communication, we refer to cohort members who were not identified as deceased beginning in 1979 as survivors, but this is not a count of confirmed survivors because the procedures missed deaths that occurred earlier in the life course.

Participants were originally tracked using commercial databases, including LexisNexis, along with web sources, including Ancestry.com. A subset of the sample was also linked to health records from the Centers for Medicare and Medicaid Services. These sources, in combination with the NDI, were used to identify PT sample members who were deceased. The NDI was also used to determine cause of death in deceased members of the cohort. [Appendix 1](#) (available online) provides a detailed description of the methods used to integrate these sources of information and promote quality control. Informed consent regulations were not established in 1960; therefore, informed consent was not obtained at the base year data collection. The study was approved by IRB at the University of Rochester Medical Center and the American Institutes for Research.

Measures

Firearm-related socialization and interest scores were the primary predictors. Ten relevant items in the baseline PT survey were identified: 3 items related to knowledge

of firearms—specifically, long guns (e.g., what double action refers to); 5 items indicating interests in vocations where firearms are used (e.g., interest in becoming a police officer); and 2 items assessing current hobbies/activities related to hunting or fishing. The baseline PT sample was randomly split into exploratory and confirmatory halves. In the exploratory subsample, initial exploratory factor analysis determined the number of factors, and then exploratory structural equation modeling was used to determine the initial fit and modifications needed to achieve adequate fit.²¹ The exploratory factor analysis produced a scree plot indicating a 2-factor solution, with 1 factor corresponding primarily to hunting/fishing interests and firearm knowledge and the other corresponding to firearm-related vocational interests. A confirmatory factor analysis showed that this 2-factor model produced excellent fit (comparative fit index=0.97, root mean square error of approximation of 0.052), and nearly identical fit statistics were obtained in the validation subsample. The 2 factors were correlated at 0.56. A full information maximum likelihood model was then fit in the full sample to estimate factor scores for those with at least two thirds of the items (96%). [Table 1](#) shows the loadings from this 2-factor model. Marked sex differences in the factor scores were noted, consistent with the era when the data were collected, which were as large as the measures of masculinity and femininity (described next). These results validated the decision to focus analyses of firearm-related socialization and interests and suicide in males. Z-scores within sex were created, with a 1-unit change in scores indicating 1 SD among males. [Appendix 2](#) (available online) provides for more information.

Masculinity, femininity, and competitive sports scores were secondary predictors of interest. Coleman and

colleagues' definition of traditional masculinity—"a set of norms that includes competitiveness, emotional restriction, and aggression"¹⁹—was adopted. The measurement scope was expanded to include stereotypic femininity, consistent with work treating masculinity and femininity as separate dimensions.²² All items in the baseline survey were identified that expressed highly gender-stereotyped activities (e.g., metal working, sewing), job aspirations (e.g., bricklayer, secretary), knowledge (e.g., sports, home economics), or personality traits (e.g., sensitivity)—a process that led to the identification of 27 candidate items. The preliminary exploratory factor analysis in the development sample yielded a scree plot suggesting 3 factors that explained 97% of the common variance. This solution held up in the confirmatory factor analysis. Factor 1 captured traditionally masculine interests and activities, Factor 2 captured traditionally feminine interests and activities, and Factor 3 captured competitive sports. Factors 1 and 2 were correlated at -0.47 , Factors 1 and 3 were correlated at 0.39 , and Factors 2 and 3 were correlated at -0.42 . A test of the criterion validity of these scores is their difference between males and females. Factor scores were standardized by the overall sample SD for ease of interpretation and to examine sex differences; raw scores yielded similar results. The distribution of z-scores reflected marked sex differences: mean z-scores for males/females for stereotypic masculinity were $0.67/-0.67$, for stereotypic femininity were $0.84/-0.85$, and for competitive sports were $0.58/-0.57$, with all comparisons highly significant ($p < 0.001$). Consistent with the focus on males, z-scores within sex for masculinity, femininity, and competitive sports interests/activities were created. [Appendix 1](#) (available online) presents more information.

To assess outcomes, deaths were coded as suicide if their underlying cause corresponded to the International Classification of Disease, Ninth Revision (before 1998) codes of 950.XX–959.XX and ICD-10 codes of X60-84, Y87.0. *Firearm-related suicides* were defined on the basis of the International Classification of Disease, Ninth Revision codes 955 and 955.4 and ICD-10 codes X72-74. These deaths represent suicide codes for which intent is clear. Unintentional poisonings and deaths with unclear intent were not coded as suicides.

Covariates including race/ethnicity, rurality, census region, and family of origin SES were included in statistical models because of the salience of these variables to firearm suicide risk in U.S. men.^{5,9,23} Personality measures of neuroticism and impulsivity were also covaried because of their salience in suicidal behavior.²⁴ Specifically, personality was measured at baseline by the PT Personality Inventory, which assessed 10 personality constructs—notably, calm and impulsivity—and has

Table 1. Firearm-Related Socialization and Interest Factors

Item	F1	F2
Hunting/fishing is a hobby	0.70	
Interested in being a professional hunter	0.80	
Knows which of several guns has the largest bore	0.44	
Knows what double action refers to	0.02	
Knows how many shells in a box of .22 caliber ammo	0.09	
Military drills are a hobby		0.68
Interested in becoming a police officer		0.53
Interested in becoming an army officer		0.77
Interested in becoming a marine officer		0.83
Interested in becoming an Air Force officer		0.82

Notes: Scores reflect item loadings on each factor. F1=hunting/fishing interests and firearm knowledge. F2=firearm-related vocational interests.

F1, Factor 1; F2, Factor 2.

since been mapped to the 5-factor model traits, including neuroticism.²⁵ Higher scores on the calm scale are strongly inversely related to neuroticism.²⁵ Therefore, the inverse of calm was used to represent neuroticism.

Statistical Analysis

The analyses were conducted in 2022. The models are contingent on surviving until 1979 and included transitions from alive to (1) firearm suicide, (2) nonfirearm suicide, and (3) all other forms of nonsuicide-related mortality. The last category was included to account for censoring because of competing risks. All predictors were examined for violations of the proportional hazards assumption and for linearity in the log hazard (i.e., whether predictors showed quadratic or other nonlinear associations with the outcome on the log hazard scale, which would necessitate transformation of those predictors to achieve proper model specification). The cubic spline–based analysis of best-fitting distribution described in Crowther and Lambert²⁶ was conducted and, on the basis of it, the Weibull distribution was used in analyses because it afforded the best fit (i.e., on the basis of the Bayesian Information Criterion and Akaike Information Criterion). The multistate models jointly modeled the primary outcome and competing risk.^{26,27}

These models used attained age as the time scale, with entry being age at baseline (i.e., the computation of time to event is the attained age at death or censoring minus the age at baseline).²⁸ An initial set of models examined the firearm socialization and masculinity factors one at a time. A final model included all predictors simultaneously, including covariates.

RESULTS

There were 152,501 male survivors in the PT cohort through age 75 years, along with 686 suicide deaths (479 firearm, 207 nonfirearm) and 36,371 deaths by other causes that are not a focus of this report. Among firearm suicide decedents, ages at death were as follows: range=35–75 years, median age of 66 years, 25th percentile of 55 years, and 75th percentile of 71 years. Among nonfirearm suicide decedents, ages at death were as follows: range=35–75 years, median age of 59.5 years, 25th percentile of 48 years, and 75th percentile of 68 years. Figure 1 shows the flow of PT cohort members. Table 2 shows descriptive statistics measured in adolescence for male survivors, firearm suicide decedents, and nonfirearm suicide decedents. Most members of the cohort were White and non-Hispanic (~91.1%),

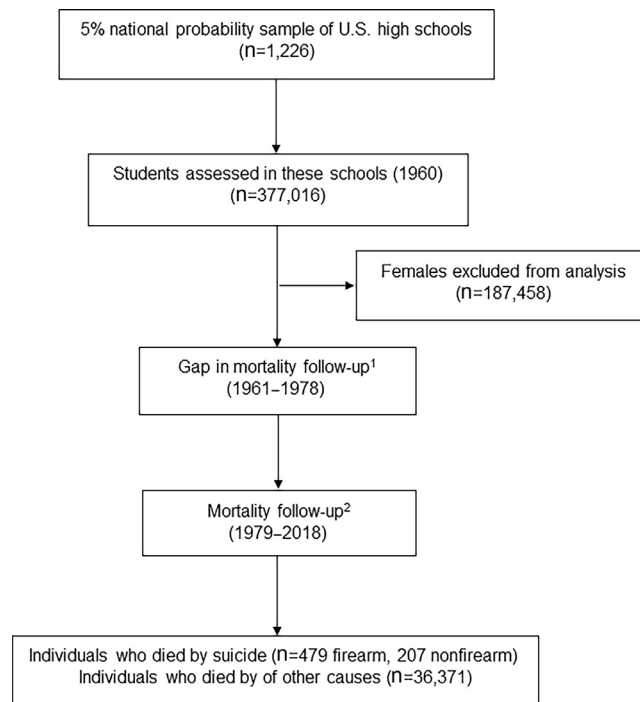


Figure 1. Flow of Project Talent Cohort.

¹The authors have knowledge of only 9 individuals who died, with no information on cause of death, in the cohort of Project Talent males prior to 1979. ²Mortality follow-up began in 1979, with the onset of the National Death Index (NDI), and continued until death or age 75, an age reached by all surviving members by 2018.

Table 2. Project Talent Male Sample Descriptive Statistics

Standardized predictors assessed in adolescence	Survivors through age 75 years (n=152,501)	Nonfirearm suicide decedents (n=208)	Firearm suicide decedents (n=466)
White, non-Hispanic	138,985 (91.1%)	191 (91.8%)	443 (95.1%)
Rural resident	18,840 (12.4%)	15 (7.2%)	55 (11.8%)
Census Region 1	40,658 (26.7%)	75 (36.1%)	102 (21.9%)
Census Region 2	49,335 (32.4%)	54 (36.0%)	141 (30.3%)
Census Region 3	43,108 (28.3%)	49 (23.6%)	154 (33.1%)
Census Region 4	19,400 (12.7%)	30 (14.4%)	69 (14.8%)
Family of origin SES	0.02 (1)	0.29 (0.95)	0.02 (0.95)
Vocational interests (in police, branch of the military)	0.00 (1)	−0.26 (1.10)	0.15 (0.93)
Hunting/fishing interests and firearm knowledge	−0.01 (1)	−0.22 (1.10)	−0.07 (1.03)
Masculinity	−0.02 (1)	−0.27 (1)	0.12 (0.99)
Femininity	−0.02 (0.99)	−0.01 (1)	−0.15 (0.90)
Competitive sports participation	0.01 (1)	−0.05 (1.06)	−0.06 (1.01)
Calm	0.01 (1)	0.00 (1.01)	−0.09 (0.97)
Impulsivity	−0.01 (1)	0.02 (0.99)	−0.01 (1.02)

Notes: Mean (SD) values are shown, except for categorical variables (top 3 rows). Predictors standardized (mean=0, SD=1) within Project Talent male participants are shown. Census regions: 1=northeast, 2=midwest, 3=south, and 4=west.

most resided in a nonrural area (~87.6%), and they were dispersed throughout the 4 regions of the U.S.

Table 3 shows the parameter estimates for each outcome of interest (i.e., firearm, nonfirearm suicide). Each predictor of interest was associated with firearm suicide ($p<0.05$). A 1-SD increase in firearm-related vocational interests in adolescence was associated with increased risk for firearm suicide (adjusted hazard ratio [AHR] [95% CI]=1.23 [1.09, 1.40]), whereas an increase in hunting/fishing interests and long gun firearm knowledge was associated with lowered risk for firearm suicide (AHR [95% CI]=0.86 [0.77, 0.96]). An increase of 1 SD in masculinity in adolescence was associated with increased risk for firearm suicide (AHR [95% CI]=1.15 [1.04, 1.28]), whereas an increase in femininity was associated with lowered risk for firearm suicide (AHR [95% CI]=0.89 [0.79, 0.99]). An increase of 1 SD in competitive sports participation in adolescence, an exploratory variable, was associated with decreased risk for firearm suicide (AHR [95% CI]=0.89 [0.80, 0.99]). Among covariates, White, non-Hispanic males, and those who resided in the South or in a rural area in adolescence were at increased risk for firearm suicide.

None of the predictors of interest were associated with nonfirearm suicide at a statistically significant level ($p<0.05$). Residing in the Midwest in adolescence was associated with a decreased risk for nonfirearm suicide, whereas residing in a rural area and with a family of origin with greater SES was associated with increased risk.

DISCUSSION

The study examined firearm-related socialization and interest and masculinity measured in high school with risk for firearm suicide over much of the adult life course in U.S. males. Specifically, suicides between ages 35 and 75 years were examined, a period in life when approximately 57% of suicides in U.S. males occur.¹ As hypothesized, interest in service in the military and police forces in adolescence is associated with increased risk for firearm suicide in U.S. men. The extent that these vocational interests in adolescence actually led to service in these professions, which are associated with increased firearm suicide risk,^{5,26,29} may explain the finding. Mechanisms may include further firearm-related socialization through these vocations, increased access to firearms through their vocational role, increased likelihood of personal ownership of a firearm among police and military service members, and the potential role of firearm use in acquired capability for suicide, a theorized psychological risk factor.^{16,30} As hypothesized, stereotypic masculinity in adolescence was associated with an increased risk for firearm suicide. Associations of masculinity with greater interest and ownership of firearms may be a mechanism.¹⁸ Another result was that femininity in adolescence lowered the risk for firearm suicide, a logical result insofar as it is in the opposite direction of the result obtained for masculinity.

Hunting/fishing interests and firearm knowledge in adolescence lowered the risk for firearm suicide, a result

Table 3. Predictors of Firearm and Nonfirearm Suicide

Predictor, measured in adolescence	Nonfirearm suicide HR (95% CI)	Firearm suicide HR (95% CI)	Nonfirearm suicide AHR (95% CI)	Firearm suicide AHR (95% CI)
White, non-Hispanic (versus minority)	1.12 (0.68, 1.83)	1.92 (1.26, 2.92)	0.98 (0.56, 1.74)	1.60 (1.01, 2.53)
Rural residence (versus nonrural)	1.83 (1.08, 3.10)	1.06 (0.80, 1.41)	1.27 (1.12, 1.43)	1.58 (1.48, 1.67)
Region 2 (versus 1)	0.59 (0.41, 0.83)	1.12 (0.87, 1.45)	0.63 (0.44, 0.91)	1.04 (0.80, 1.37)
Region 3 (versus 1)	0.60 (0.42, 0.86)	1.39 (1.08, 1.79)	0.69 (0.47, 1.02)	1.38 (1.05, 1.81)
Region 4 (versus 1)	0.84 (0.55, 1.28)	1.41 (1.04, 1.92)	0.84 (0.52, 1.34)	1.35 (0.97, 1.88)
SES of family of origin	1.33 (1.16, 1.54)	1.01 (0.92, 1.11)	1.27 (1.08, 1.50)	1.04 (0.93, 1.15)
Vocational interests (in police, military branch)	0.79 (0.69, 0.89)	1.17 (1.06, 1.30)	0.87 (0.74, 1.03)	1.23 (1.09, 1.40)
Hunt/fish interests and firearm knowledge	0.81 (0.71, 0.93)	0.94 (0.85, 1.03)	0.96 (0.81, 1.14)	0.86 (0.77, 0.96)
Masculinity	0.76 (0.66, 0.88)	1.13 (1.03, 1.25)	0.86 (0.73, 1.01)	1.15 (1.04, 1.28)
Femininity	1.00 (0.87, 1.15)	0.86 (0.78, 0.95)	1.03 (0.88, 1.20)	0.89 (0.79, 0.99)
Competitive sports participation	0.95 (0.82, 1.09)	0.93 (0.85, 1.03)	0.98 (0.84, 1.14)	0.89 (0.80, 0.99)
Calm	1.00 (0.87, 1.15)	0.91 (0.83, 1.00)	0.95 (0.82, 1.11)	0.93 (0.84, 1.03)
Impulsivity	1.02 (0.89, 1.17)	0.99 (0.91, 1.09)	1.01 (0.87, 1.17)	1.01 (0.91, 1.11)

Notes: Boldface indicates statistical significance ($p < 0.05$).

Shown are predictors standardized within PT male participants, except for categorical variables (top 3 rows). Census regions: 1=northeast, 2=midwest, 3=south, and 4=west. HR is unadjusted, whereas AHR is fully adjusted.

AHR, adjusted hazard ratio; HR, hazard ratio; PT, Project Talent.

that was not hypothesized. Although the role of long guns in suicide in the U.S. should not be dismissed,³¹ handguns are used in more than three quarters of firearm suicides.³¹ Yet, knowledge about long guns was the focus of the PT firearm knowledge items. A possible mechanism for a protective effect is that socialization to long guns, including through hunter-education courses that emphasize safety to humans, creates the expectation that firearms are to be used exclusively in hunting or sport, lowering the potential for diversion for harmful use toward humans, including in suicide. However, quality research to test this idea is lacking, and the diversity of hunter-education courses and licensing requirements, which vary by state, create significant challenges to research efforts.

Competitive sports participation in adolescence, an exploratory variable, was also associated with lowered risk for firearm suicide, consistent with data on mental health benefits of sports participation in youth, benefits that may be attributable to the health promotion effects of physical exercise, increased connectedness with peers and adult role models (e.g., coaches), among other mechanisms.³² Results pertaining to the covariates were unsurprising, with the exception of the result indicating increased risk for nonfirearm suicide associated with higher SES of family of origin. Further research on this question is needed.

Limitations

The study did not examine firearm suicide in women.³³ The cohort was gathered in 1960 when

smaller portions of the U.S. population were racial and ethnic minorities and when there were more rigid gender roles and expectations. There is unclear generalizability of results to non-high school attendees. Mortality follow-up did not begin until 1979 when the cohort had a mean age of 35.7 years, and it did not extend beyond age 75 years. Among U.S. males, approximately 33% of suicides occur before the age of 35 years, and 10% occur after the age of 75 years,¹ suicides that would be missed in the analyses. Assessments of variables occurring between adolescence and death, including vocational, medical, social, behavioral, and environmental factors, were not available. Of particular relevance, PT cohort members born in 1944 or later were eligible for the military draft, representing 52.5% of the sample, yet data on military service, including deployment to Vietnam, either as conscripts or enlistees, were not available. Likewise, data on service in police professions were not available. Measures of firearm-related socialization and masculinity were developed within the sample. PT knowledge items referred to long guns used in hunting. Because socialization to hunting involves these guns, the relevance to privately owned assault weapons, which have become more common, is unclear. Interests in hunting or fishing were assessed (rather than interests in hunting alone). Region, rurality, or other macrolevel variables associated with firearm suicide at the time of death were not considered because these were not available in survivors in the cohort over follow-up.

CONCLUSIONS

A range of approaches is required to prevent firearm suicide deaths.³⁴ Interests in military and police vocations and stereotypic masculinity are common characteristics in adolescence that predict firearm suicide risk over much of the adult life course in men, underscoring the practical significance and public health importance of developing preventive strategies for males with these characteristics. Results further suggest that competitive sports participation in adolescence as well as education and socialization to long guns through hunting and related interests decrease long-term firearm suicide risk. However, these potential protective effects are novel and were not hypothesized, requiring further research.

ACKNOWLEDGMENTS

The research presented in this paper is that of the authors and does not reflect the official policy of the NIH. The study sponsor had no role in the study design; collection, analysis, and interpretation of data; writing of the report; or the decision to submit the report for publication.

This work was supported by Award [1R61AG072408-01](#) (BPC and KRC) from the National Institute on Aging of NIH.

The results have not been previously reported elsewhere.

No financial disclosures have been reported by the authors of this paper.

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SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at <https://doi.org/10.1016/j.amepre.2023.11.006>.

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