Individual and Area Level Factors Associated with Firearm Mortality among U.S. Army Veterans and Servicemembers

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Background

Critical Statistics

Injuries resulting from a firearm were responsible for nearly two-thirds of all deaths from suicide among Veterans of U.S. military service.

Policy Impact

Policies related to universal background checks and mandatory permits for firearm purchase have been associated with significant differences in rates of firearm mortality.

Implementation Effects

Implementation of restrictive policies and multiple concurrent policies have been associated with the largest reductions in mortality risk.

Background Continued

Firearm Availability and Risk

Greater availability of firearms in the population has been consistently associated with increased risk for suicide mortality. This relationship demonstrates a clear pattern across demographic groups and geographic regions.

Mental Health Associations

Risk of suicide mortality is significantly increased among individuals with depression and other mental health disorders. However, the relationships between mental health status and firearm ownership, use, and mortality are complex.

Previous Research Findings

Previous analyses, including those conducted by members of this research team, identified surprisingly weak and limited associations between mental health disorders and either firearm ownership or carrying behaviors among Veterans.

Research Objectives

The primary objective of this comprehensive longitudinal study was to identify specific associations between individual characteristics, military service history, and area-level policy factors with risk for firearm-related mortality among U.S. Army personnel and Veterans.

01

All-Cause Suicide Mortality

Comprehensive analysis of suicide deaths regardless of method, providing baseline mortality patterns and risk factors.

02

Firearm-Specific Suicide Mortality

Focused examination of suicide deaths specifically resulting from firearm injuries, representing the most lethal method.

03

All-Cause Firearm Mortality

Broad assessment including suicide, accidental, and homicide deaths involving firearms to capture comprehensive firearm-related mortality patterns.

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Data Sources

STARRS All Army Survey Data

Comprehensive self-reported survey responses including gun ownership patterns, gun carrying behavior, lifetime stressful events, and detailed symptoms of mental health disorders from the Pre/Post Deployment Study Consolidated Data File.

National Death Index

Complete mortality data through 2019 including precise date, state of death, and comprehensive cause of death information derived from standardized ICD-9 and ICD-10 diagnostic codes.

RAND Gun Law Database

Detailed state-level firearm legislation data resource containing comprehensive information on gun laws and their specific dates of implementation and enforcement.

Army Administrative Records

Person-month administrative records including Defense Manpower Data Center information, duty location assignments, demographic data, and mental health diagnoses documented during active duty service.

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Methodology

Study Design

This longitudinal cohort study examined comprehensive data from the Army STARRS AAS/PPDS consolidated cohort (n=29,823) through the extended period following their initial survey response through 2019.

Residence Tracking

Place of residence was treated as time-varying and systematically obtained from Army administrative records, mailing addresses from survey records, or place of death documentation.

Variable Treatment

All other demographic and clinical variables were treated as fixed over time to maintain analytical consistency and interpretability.

Data Collection Period

Baseline survey data were systematically collected between 2011 and 2012, establishing comprehensive individual and clinical profiles.

Mental Health Assessment

Mental health factors were assessed through both self-report mechanisms and independent administrative records to ensure comprehensive coverage.

Risk Period and Analysis

The period of mortality risk began at baseline survey completion and was normalized to account for variable time at risk. Risk assessment utilized discrete time series models with six-month and twelve-month intervals.

Mortality Outcomes

88

All-Cause Suicides

Total deaths resulting from suicide across all methods during the study period

61

Firearm Suicides

Suicide deaths specifically resulting from firearm injuries, representing 69% of all suicides

81

All Firearm Deaths

Comprehensive firearm-related deaths including suicide, accidental, and homicide

These mortality statistics represent the foundation of our longitudinal analysis, demonstrating the predominance of firearm-related deaths in military suicide patterns and the critical need for comprehensive prevention strategies.

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Risk Over Time Analysis

Temporal patterns of mortality risk were analyzed using both twelve-month and six-month interval models to capture both long-term trends and shorter-term variations in risk patterns. This dual analytical approach provides comprehensive insight into the temporal dynamics of firearm mortality risk.

The analysis reveals distinct temporal patterns in mortality risk, with significant implications for targeted intervention timing and resource allocation. Both analytical intervals demonstrate consistent patterns while revealing unique temporal variations that inform prevention strategy development.

Multivariate Analysis: Suicide Mortality

Comprehensive multivariate modeling identified key individual and systemic factors associated with overall suicide mortality risk. This analysis controls for multiple confounding variables to isolate specific risk factors and their relative contributions to mortality outcomes.

The multivariate analysis reveals complex patterns of association between demographic, military service, and clinical factors with suicide mortality risk. Individual characteristics demonstrate varying levels of statistical significance, with some factors showing unexpected relationships that challenge conventional assumptions about suicide risk in military populations.

	All Suicide Deaths (n=88)		
	OR	LCI	UCI
Female	0.26	0.06	1.10
AltEd+GED vs H.S.	**2.565**	**1.142**	**5.759**
S/College/+ vs 02.H.S.	**0.35**	**0.12**	**0.99**
Rank: E1/E2 vs 02.E3/E4	**5.761**	**2.54**	**13.067**
Rank: E5/E6 vs 02.E3/E4	1.42	0.64	3.14
Rank: E7+ vs 02.E3/E4	1.10	0.44	2.79
Age at Entry: 17-20 vs 21 - 24	1.08	0.49	2.38
Age at Entry 25+ vs 21 - 24	1.40	0.22	9.00
Time in Service: 1-2 Years vs 5-10	0.68	0.32	1.45
Time in Service: 3-4 Years of Service vs 5-10 Years	0.48	0.21	1.09
Time in Service: .>10 Years vs 5-10 Years of Service	0.35	0.12	1.01
Dependents: 1+ vs 0	0.59	0.30	1.18
PTSD (combined) 1 vs 0	**1.706**	**1.032**	**2.82**
Firearm Access: Any vs 0	0.55	0.18	1.73
Firearm Access 2 vs 0	2.82	0.98	8.14
BgCk_PrivateSales 1 vs 0	1.39	0.64	3.01
BgCk_DealerSales 1 vs 0	**0.378**	**0.17**	**0.84**
DVremoval_required 1 vs 0	0.60	0.29	1.21
CCW_ShallIssue vs Noperm	1.73	0.82	3.65
PurchasePermit_maxWait	**0.313**	**0.116**	**0.844**
PP_MH_Incompetent	**2.786**	**1.235**	**6.282**
PP_MH_Comitted	0.61	0.20	1.84

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Multivariate Analysis: Firearm Suicide

Focused analysis of firearm-specific suicide mortality reveals distinct risk factor patterns compared to all-cause suicide. This analysis specifically examines factors associated with the most lethal method of suicide among military personnel.

The firearm suicide analysis demonstrates method-specific risk patterns that differ meaningfully from general suicide risk factors. These findings have significant implications for targeted prevention efforts and suggest that firearm-specific interventions may require distinct approaches compared to general suicide prevention strategies.

Notably, certain demographic and service-related factors show stronger associations with firearm suicide than with suicide by other methods, indicating the importance of method-specific risk assessment and intervention strategies.

	Firearm Suicide (n=61)		
	OR	LCI	UCI
Female	**0.09**	**0.012**	**0.69**
AltEd+GED vs H.S.	1.872	0.699	5.011
S/College/+ vs 02.H.S.	0.445	0.181	1.093
Rank: E1/E2 vs 02.E3/E4	**7**	**2.557**	**19.165**
Rank: E5/E6 vs 02.E3/E4	2.339	0.894	6.122
Rank: E7+ vs 02.E3/E4	1.887	0.626	5.689
Age at Entry: 17-20 vs 21 - 24	**2.753**	**1.037**	**7.307**
Age at Entry 25+ vs 21 - 24	4.082	0.954	17.471
Time in Service: 1-2 Years vs 5-10	0.633	0.311	1.287
Time in Service: 3-4 Years of Service vs 5-10 Years	0.397	0.139	1.133
Time in Service: .>10 Years vs 5-10 Years of Service	0.314	0.077	1.279
Dependents: 1+ vs 0	0.415	0.157	1.101
PTSD (combined) 1 vs 0	1.631	0.491	5.422
Firearm Access: Any vs 0	0.772	0.221	2.703
Firearm Access 2 vs 0	2.108	0.692	6.421
BgCk_PrivateSales 1 vs 0	1.488	0.48	4.614
BgCk_DealerSales 1 vs 0	**0.268**	**0.098**	**0.732**
DVremoval_required 1 vs 0	**0.247**	**0.113**	**0.543**
CCW_ShallIssue vs Noperm	0.427	0.056	3.225
PurchasePermit_maxWait	**0.174**	**0.047**	**0.644**
PP_MH_Incompetent	**6.79**	**2.37**	**19.452**
PP_MH_Comitted	0.604	0.145	2.513

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Multivariate Analysis: All-Cause Firearm Mortality

Comprehensive firearm mortality analysis encompassing suicide, accidental, and homicide deaths provides the broadest perspective on firearm-related risk factors. This inclusive analysis captures the full spectrum of firearm mortality among military personnel.

Comprehensive Risk Assessment

All-cause firearm mortality analysis reveals broader patterns of risk that extend beyond intentional self-harm to include accidental and interpersonal violence outcomes.

Integrated Prevention Implications

Results suggest that comprehensive firearm safety interventions may address multiple mortality outcomes simultaneously, providing efficiency opportunities for prevention programs.

	All Firearm Deaths (n=81)		
	OR	LCI	UCI
Female	**0.14**	**0.03**	**0.56**
AltEd+GED vs H.S.	1.503	0.57	3.964
S/College/+ vs 02.H.S.	**0.46**	**0.21**	**0.97**
Rank: E1/E2 vs 02.E3/E4	**4.84**	**1.78**	**13.17**
Rank: E5/E6 vs 02.E3/E4	1.758	0.684	4.518
Rank: E7+ vs 02.E3/E4	1.45	0.516	4.074
Age at Entry: 17-20 vs 21 - 24	2.307	0.99	5.379
Age at Entry 25+ vs 21 - 24	3.085	0.803	11.855
Time in Service: 1-2 Years vs 5-10	0.675	0.328	1.387
Time in Service: 3-4 Years of Service vs 5-10 Years	0.388	0.146	1.029
Time in Service: .>10 Years vs 5-10 Years of Service	0.323	0.096	1.088
Dependents: 1+ vs 0	0.452	0.187	1.09
PTSD (combined) 1 vs 0	1.732	0.607	4.949
Firearm Access: Any vs 0	0.651	0.198	2.144
Firearm Access 2 vs 0	1.954	0.725	5.267
BgCk_PrivateSales 1 vs 0	1.427	0.541	3.769
BgCk_DealerSales 1 vs 0	**0.32**	**0.14**	**0.75**
DVremoval_required 1 vs 0	**0.23**	**0.11**	**0.49**
CCW_ShallIssue vs Noperm	0.537	0.098	2.956
PurchasePermit_maxWait	**0.15**	**0.04**	**0.50**
PP_MH_Incompetent	**5.54**	**2.22**	**13.82**
PP_MH_Comitted	0.667	0.192	2.319

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Policy Associations with Firearm Mortality

State-level firearm policy analysis reveals significant associations between specific legislative approaches and mortality outcomes. This analysis examines the real-world effectiveness of various policy interventions in reducing firearm mortality risk among military personnel.

The policy analysis demonstrates variable effectiveness across different legislative approaches, with certain policies showing consistent protective effects while others demonstrate unexpected associations. These findings provide critical evidence for policy development and implementation strategies.

Understanding these policy-level associations enables evidence-based recommendations for legislative approaches that may effectively reduce firearm mortality among military populations while respecting constitutional and practical considerations.

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Discussion: Key Risk Factors

Individual Risk Factors

In comprehensive multivariate models, risk for firearm suicide was significantly associated with specific demographic and military service characteristics. Gender, military rank at time of survey completion, and age of entry into military service emerged as the most consistent predictors across analytical models.

Mental Health Associations

Lifetime history of PTSD demonstrated significant associations with increased risk for death in bivariate analyses. However, these associations showed varying significance levels depending on the inclusion of other covariates in multivariate models.

Clinical Implications

The complex relationship between PTSD and firearm mortality suggests that mental health screening and intervention strategies may need to account for multiple interacting factors rather than relying on single diagnostic criteria.

Methodological Considerations

The variability in mental health associations across different model specifications highlights the importance of comprehensive analytical approaches that account for multiple potential confounding factors and interaction effects.

Discussion: Policy Effectiveness

Protective Policies

State-level policies significantly associated with lower odds of firearm suicide included mandatory background checks for dealer sales, mandatory firearm removal in cases involving domestic violence, and enforcement of maximum waiting periods following firearm purchase.

Paradoxical Findings

Increased odds of suicide resulting from firearm injury were paradoxically associated with state policies prohibiting firearm ownership among those deemed incompetent based on mental health status, suggesting potential unintended consequences.

Consistent Patterns

Similar associations with state-level firearm policies were consistently observed across all three mortality outcomes, indicating broad effectiveness of certain policy approaches.

These findings provide critical evidence for policy makers considering firearm legislation, demonstrating both the potential benefits and unexpected complexities of different regulatory approaches in reducing military-related firearm mortality.

Summary of Key Findings

1 Mental Health Disorder Associations

Mental health disorders were not significantly associated with firearm suicide or all-cause firearm mortality in fully adjusted multivariate models, challenging conventional assumptions about mental health as a primary risk factor.

2 Firearm Access Relationships

Individual access to firearms was not associated with increased suicide or all-cause firearm mortality in fully adjusted models, suggesting that policy-level interventions may be important additions to individual-level restrictions.*

3 Policy Effectiveness

Comprehensive policies including mandatory background checks and maximum waiting periods were consistently associated with decreased risk for suicide and all-cause firearm mortality.

4 Temporal Risk Patterns

Distinct patterns of risk for suicide and firearm mortality were identified. Changes in firearm-related mortality rates do not fully explain the observed increases in all-means suicide, indicating multiple contributing factors.

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Study Limitations

Statistical Power Constraints

Analyses were based on comparatively small event counts across the three mortality outcomes, which may have significantly impacted our ability to identify statistically significant associations and limited the precision of effect size estimates.

Geographic and Policy Assumptions

Assumptions related to individuals' place of residence over time and the corresponding effect of state-level firearm policies may have introduced measurement error and impacted the accuracy of policy association measures.

Policy Impact Measurement

Relationships between firearm legislation and individual-level mortality risk may not accurately reflect the cumulative impact of these policies, as implementation effectiveness varies across jurisdictions and time periods.

Temporal Considerations

The time-varying nature of policy implementation and individual residence patterns creates analytical complexity that may not fully capture the dynamic relationships between policy environments and mortality outcomes.

These limitations should be considered when interpreting study findings and developing policy recommendations, particularly regarding the generalizability of results to broader military and veteran populations.

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For questions regarding this research, methodology, or potential collaborations, please contact the corresponding author. Additional study materials and detailed analytical results may be available upon request.

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