Risk and Protective Factors Across Socioecological Levels of Risk for Suicide: An Evidence Map

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PREFACE

The VA Evidence Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted healthcare topics of importance to clinicians, managers, and policymakers as they work to improve the health and healthcare of Veterans. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The program comprises three ESP Centers across the US and a Coordinating Center located in Portland, Oregon. Center Directors are VA clinicians and recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Center Program. The Coordinating Center was created to manage program operations, ensure methodological consistency and quality of products, and interface with stakeholders. To ensure responsiveness to the needs of decision-makers, the program is governed by a Steering Committee composed of health system leadership and researchers. The program solicits nominations for review topics several times a year via the program website.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, Deputy Director, ESP Coordinating Center at Nicole.Floyd@va.gov.

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This report is based on research conducted by the Evidence Synthesis Program (ESP) Center located at the **Minneapolis VA Health Care System, Minneapolis, MN**, funded by the Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development. The findings and conclusions in this document are those of the author(s) who are responsible for its contents; the findings and conclusions do not necessarily represent the views of the Department of Veterans Affairs or the United States government. Therefore, no statement in this article should be construed as an official position of the Department of Veterans Affairs. No investigators have any affiliations or financial involvement (*eg*, employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties) that conflict with material presented in the report.

ACKNOWLEDGMENTS

This topic was developed in response to a nomination by VA Health Services Research & Development (HSR&D) Office for an evidence review on the risk and protective factors for suicide across socioecological (SE) levels of risk. The scope was further developed with input from the topic nominators (*ie*, Operational Partners), the ESP Coordinating Center, the review team, and the technical expert panel (TEP).

In designing the study questions and methodology at the outset of this report, the ESP consulted several technical and content experts. Broad expertise and perspectives were sought. Divergent and conflicting opinions are common and perceived as healthy scientific discourse that results in a thoughtful, relevant systematic review. Therefore, in the end, study questions, design, methodologic approaches, and/or conclusions do not necessarily represent the views of individual technical and content experts.

The authors gratefully acknowledge the following individuals for their contributions to this project:

Operational Partners

Operational partners are system-level stakeholders who have requested the report to inform decision-making. They recommend TEP participants; assure VA relevance; help develop and approve final project scope and timeframe for completion; provide feedback on draft report; and provide consultation on strategies for dissemination of the report to field and relevant groups.

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Technical Expert Panel (TEP)

To ensure robust, scientifically relevant work, the TEP guides topic refinement; provides input on key questions and eligibility criteria, advising on substantive issues or possibly overlooked areas of research; assures VA relevance; and provides feedback on work in progress. TEP members are listed below:

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Peer Reviewers

The Coordinating Center sought input from external peer reviewers to review the draft report and provide feedback on the objectives, scope, methods used, perception of bias, and omitted evidence. Peer reviewers must disclose any relevant financial or non-financial conflicts of interest. Because of their unique clinical or content expertise, individuals with potential conflicts may be retained. The Coordinating Center and the ESP Center work to balance, manage, or mitigate any potential nonfinancial conflicts of interest identified.

TABLE OF CONTENTS

FIGURES

APPENDICES

ABBREVIATIONS TABLE

ACE	Adverse Childhood Experiences
BMI	Body mass index
CDC	Centers for Disease Control and Prevention
DoD	Department of Defense
ESP	Evidence Synthesis Program
HSR&D	Health Services Research & Development
IED	Improvised explosive device
KQ	Key Question
MeSH	Medical Subject Heading
OEF/OIF	Operation Enduring Freedom/Operation Iraqi Freedom
PTSD	Posttraumatic stress disorder
QUIPS	Quality in Prognosis Studies
ROB	Risk of bias
SEM	Social-ecological Model
STARRS	Study to Assess Risk and Resilience in Servicemembers
TBI	Traumatic brain injury
TEP	Technical Expert Panel
US	United States
VA	Veterans Affairs
VHA	Veterans Health Administration

EVIDENCE REPORT

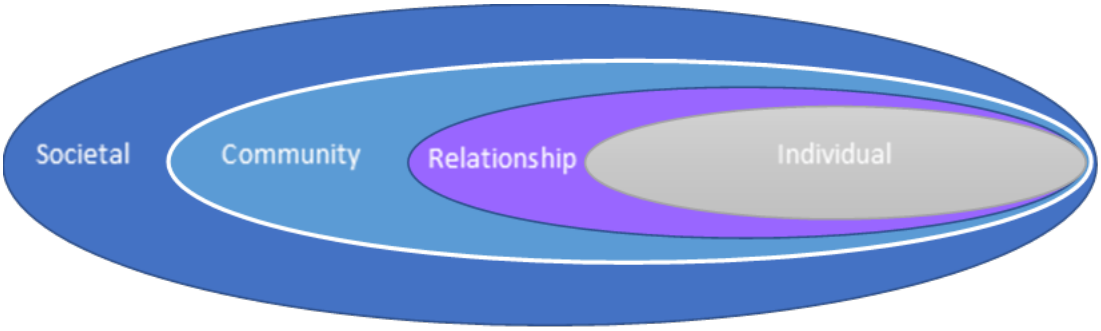
INTRODUCTION

Suicide remains a critical public health concern, with suicide rates increasing by 33% in the United States (US) between 1999 and 2019. Suicide rates vary by sex, race, age, and occupation, including military service, the latter of which is independently associated with increased risk for suicide. The suicide rate among US Veterans is 1.5 times that of the general population, when adjusted for age and sex.[1] While Veterans comprise only 8% of the US population, 13.8% (6,435) of all suicides in 2018 occurred in Veterans.[1] Similar to the general population, male sex, non-Hispanic white race, mental health diagnoses, and age (55-74), are risk factors in Veterans. Therefore, suicide prevention is the highest priority for the US Department of Veterans Affairs (VA).[2]

The National Strategy for Preventing Veteran Suicide 2018–2028[2] has outlined several goals, including increased surveillance and research to identify at-risk individuals and evaluate additional potential risk and protective factors. As further outlined in the 2020 National Veteran Suicide Annual Report, Veterans and active military "do not live, work, and serve in isolation….",[1] recognizing that risk and protective factors are not confined solely to the individual. Therefore, evaluating these factors through the lens of a socioecological framework can provide context for developing suicide prevention policies and practices.

The Centers for Disease Control and Prevention (CDC) suggests that prevention efforts for any health or disease issue require an understanding of the underlying factors that influence the issue. The CDC's Social-Ecological Model (SEM) (Figure 1) is a 4-tiered framework for organizing risk and protective factors, which may then inform prevention strategies.[3] The 4 strata, from macro to micro level are: Societal (factors concerning large-scale issues such as social and cultural norms, and guiding rules such as policies or laws); Community (factors limited to a certain region like a neighborhood, school, or workplace); Relational (factors involved with direct person-to-person interaction); Individual (person characteristics such as demographics, health, and beliefs). The overlapping rings of the SEM illustrate how factors at each level (individual, relationship, community, and society) impact factors at other levels; as do the various risk and protective factors associated with suicide. Table 1 provides a list of examples as to how different factors could be categorized within the model. Depending on how they are operationalized, some factors could conceptually fit into multiple categories.

Figure 1. Social-Ecological Model*



*https://www.cdc.gov/violenceprevention/publichealthissue/social-ecologicalmodel.html

Table 1. Examples of Risk Factors for Each Domain within the Social-Ecological Model[a]

Individual	Relationship
• Previous suicide attempt • Mental illness, such as depression • Gender • Criminal problems • Financial strain • Impulsive or aggressive tendencies • Job problems/unemployment • Legal problems • Serious illness • Substance use disorder	• Adverse childhood experiences such as child abuse and neglect • Bullying • Family history of suicide • Relationship problems such as a break-up, violence, or loss • Sexual violence
Community	**Societal**
• Barriers to health care • Cultural and religious beliefs, such as a belief that suicide is a noble resolution of a personal problem • Suicide cluster in a community	• Economic downturn/depression • Seasonal variation • Stigma associated with mental illness or help-seeking • Easy access to lethal means, such as firearms or medications • Unsafe media portrayals of suicide

[a]Examples were derived from the CDC[3] and a systematic review done by Cramer et al[5]

This is the second of a 2-part review nominated by VA Health Services Research and Development (HSR&D). The first review focused on community-based interventions for suicide prevention.[39] This second review focuses on research conducted since 2011 that reported risk and protective factors related to suicide or suicide attempt in Veteran or active duty military populations. The topic was nominated by VA HSR&D to further develop research priorities and identify areas for future funding on suicide prevention in VA. In collaboration with VA leadership and members of a Technical Expert Panel (TEP) the following Key Question was developed: *What are the risk and protective factors for suicidal behaviors (attempts or death by suicide) across social-ecological levels of risk?*

To answer this question, we provide an evidence map of identified risk and protective factors for suicidal behaviors in populations not known to be at high risk (*eg*, populations limited to those with mental health disorders or known prior suicide attempts). Evidence maps involve a systematic search of a broad field to identify gaps in knowledge and/or future research needs and presents results in a user-friendly format, often a visual figure or graph, or a searchable database.[40] Evidence maps are useful when there is both abundance and diversity of research. Their main utility is for displaying areas where research is concentrated and gaps that need to be addressed. Using the CDC Social-Ecological Model,[3] we categorized the reported risk and protective factors into 1 of 4 domains: Individual, Relational, Community, or Societal. We summarize studies by categories within this framework without commenting on the results or findings of individual studies.

METHODS

TOPIC DEVELOPMENT

The topic was nominated by VA Health Services Research and Development to further develop research priorities and identify areas for future funding on suicide prevention in VA. We worked with the Operational Partners and a Technical Expert Panel to refine the scope, key questions, and inclusion/exclusion criteria. We developed a protocol with input from our partners and registered in PROSPERO (CRD4202123641). The following Key Question was developed: *What are the risk and protective factors for suicidal behaviors (attempts or death by suicide) across social-ecological levels of risk?*

SEARCH STRATEGY

We searched MEDLINE, Embase, PsycINFO, and Sociological Abstracts (Appendix A) from January 2011 to January 2021. We limited our search from 2011 to avoid duplication with a 2012 VA ESP review that used inclusion criteria similar to the present review.[37] We used Medical Subject Headings (MeSH) and title/abstract terms indicative of suicide outcomes and risk or protective factors. We supplemented these results with additional hand searches of bibliographies from recent systematic reviews and with references from our technical expert panel.

STUDY SELECTION

Eligible citations were screened independently by 2 reviewers using Distiller SR (Distiller SR, Evidence Partners, Ottawa, Canada) with prespecified criteria. Citations moved to full-text review if either reviewer considered the citation eligible. At full-text review, agreement of 2 reviewers was needed for study inclusion or exclusion; disputes were resolved by discussion with input from a third reviewer, if needed.

We included observational studies in the English-language that evaluated "modifiable" risk or protective factors for suicides or suicide attempts (*ie,* not sex, race, or age) in samples drawn from general populations of US Veterans and active military personnel. Studies must have reported suicide deaths or suicide attempts as outcomes; studies which included only composite outcomes (*eg*, suicide deaths plus attempts as 1 outcome) were excluded. Studies that did not capture the risk or protective factor(s) prior to the outcome of suicide or suicide attempts were excluded. We also excluded studies of special populations (*eg*, those known to be high risk due to mental health diagnoses or past suicide attempts) unless results were reported separately for individuals not considered at increased risk. However, we included studies of a general population of Veterans or active Service members that described their study sample's mental health diagnoses or past suicide attempts as risk factors.

Table 2. Inclusion and Exclusion Criteria

	Inclusion Criteria	Exclusion Criteria
Population	Community-dwelling US Veteran or active military population (18 years of age or older)	Studies including >50% participants with increased risk of suicide due to prior suicide attempters or with specific mental or physical health conditions known to increase suicide risk: depression; psychoses, PTSD, recent cancer diagnosis, or terminal illness (unless results are stratified) Studies looking explicitly at genetic factors associated with suicide risk
Intervention	NA	NA
Comparator	NA	NA
Outcomes	Suicide attempts, suicide deaths	Composite outcome of suicide deaths plus attempts
Timing	Risk factors must precede the suicide/suicide attempt	Studies that do not capture the outcome of suicide/suicide attempt prior to the risk factor(s) of interest in the study
Setting	United States	Any
Study Design	Observational population-based studies published January 2011 – January 2021 that examine risk factors for suicide deaths and/or suicide attempts. Studies will capture risk factors/variables of interest, prior to (preceding) the outcomes of interest (suicide, suicide attempt).	Systematic reviews, narrative reviews, case reports, editorials, commentary, conference abstracts, interventions, and non-English language publications
Prognostic or Risk Factors	Any	Studies looking at physiological, laboratory, or imaging studies will be excluded (must have a clinical history or risen to the level of diagnosis; *ie,* we would include diabetes as a risk, but not A1C levels as measured by laboratory tests)

QUALITY ASSESSMENT AND DATA ABSTRACTION

Risk of bias (ROB) was assessed using the Quality In Prognosis Studies (QUIPS) tool.[4] The QUIPS tool uses 6 domains to critically appraise studies of prognostic factors (participation, attrition, prognostic factor measurement, outcome measurement, study confounding, and statistical analysis and reporting). Any study which was rated high in 2 or more domains was considered high ROB overall. Any study which was rated low ROB in all 6 domains was considered low ROB overall. Studies which did not meet either of those conditions were considered moderate ROB overall. Ratings for all eligible studies can be found in Appendix B.

We abstracted data from eligible studies on study and population characteristics, number of participants, data source, prognostic factors reported, and outcomes reported. We also reviewed and reported the analytic models and variables used to assess for possible independent effects. For studies rated low or moderate ROB, we abstracted the direction of the association between

the risk or protective factor and the outcome, based on statistical significance. ROB assessments and data abstraction were conducted by 1 trained reviewer and verified or modified by a second reviewer.

DATA SYNTHESIS

Due to the heterogeneity of identified studies, the large number of identified risk and protective factors, and variation in reporting of risk and protective factors, we prepared an evidence map rather than a quantitative synthesis of results or detailed analyses of individual studies. Evidence maps involve a systematic search of a broad field to identify gaps in knowledge and/or future research needs and present results in a user-friendly format, often a visual figure or graph, or a searchable database.[40] Evidence maps are useful when there is an abundance and a diversity of research as a first step to a systematic review on all or a portion of the topic or to identify gaps in a topic area. They display where research is concentrated and gaps that need to be addressed. Using the CDC Social-Ecological Model,[3] we categorized the reported risk and protective factors into 1 of 4 domains: Individual, Relational, Community, or Societal. We summarize studies by categories within this framework without commenting on the results or findings of individual studies.

We also summarize findings from studies with the strongest methodological study design, prospective cohort studies. In addition to reporting of prospective cohort studies, we summarize findings from any low risk of bias study regardless of study design (prospective, retrospective cohort, case-control, cross-sectional) as other methodologic criteria are used to assess the credibility of findings for a given outcome, including attrition, analytic methods, and the measurement of prognostic factors, outcomes, and confounders.

RATING THE BODY OF EVIDENCE

A formal certainty of evidence rating was not conducted as part of this review.

PEER REVIEW

A draft version of this report was reviewed by content experts and VA operational partners. Their comments and our responses are presented in Appendix C and the report was modified as needed.

RESULTS

OVERVIEW OF ALL ELIGIBLE STUDIES

After removing duplicates, we identified 1,351 citations for title and abstract triage. We reviewed the full text of 295 articles and identified 63 which met our inclusion criteria (Figure 2).

The majority (k=36) of studies were from large database s with sample sizes ≥ 100,000. Few studies (k=8) had sample sizes < 1,000. Most studies did not report the era of service for their samples, but when reported, the most common era of service was Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) for both active duty and Veterans. Most studies were retrospective cohorts by design (k=41) and few studies (k=7) were prospective cohort studies (Table 3).

Seventeen studies used data from the Study to Assess Risk and Resilience in Service members (STARRS) (Table 3). Most studies (k=52) combined 1 or more large databases, typically Veteran's Health Administration (VHA) or Department of Defense (DoD) with other databases such as the National Death Index (NDI). The remaining 11 studies used only 1 data source, either VHA or DoD data. It is likely that many studies evaluated overlapping groups of individuals and predictive variables though it was not possible to determine.

No eligible studies reported on risk or prognostic factors in the societal domain of the Social-Ecological Model; few studies (k=3) reported on factors within the community domain. Almost all studies (k=57) reported on factors within the individual domain, and approximately one-third (k=24) reported on relational factors. Of the 24 studies which reported a relational factor, the most common factor was marital status or problem with an intimate relationship (k=17).

Of the 63 eligible articles, 14 were rated as low ROB,[7,11,27,28,30,36,41-48] 41 rated as moderate ROB,[6,8-10,12-26,31-33,35,49-66] and the remaining 8 were rated as high ROB[67-74] and not analyzed further. For all low and moderate ROB studies, detailed evidence tables containing study characteristics, risk or protective factors reported, variables used for adjustment in models to control for potential confounding effects and assess potential independent roles for the reported factors, and direction of identified effects can be found in Appendix Table D1.

Figure 2. Literature Flow

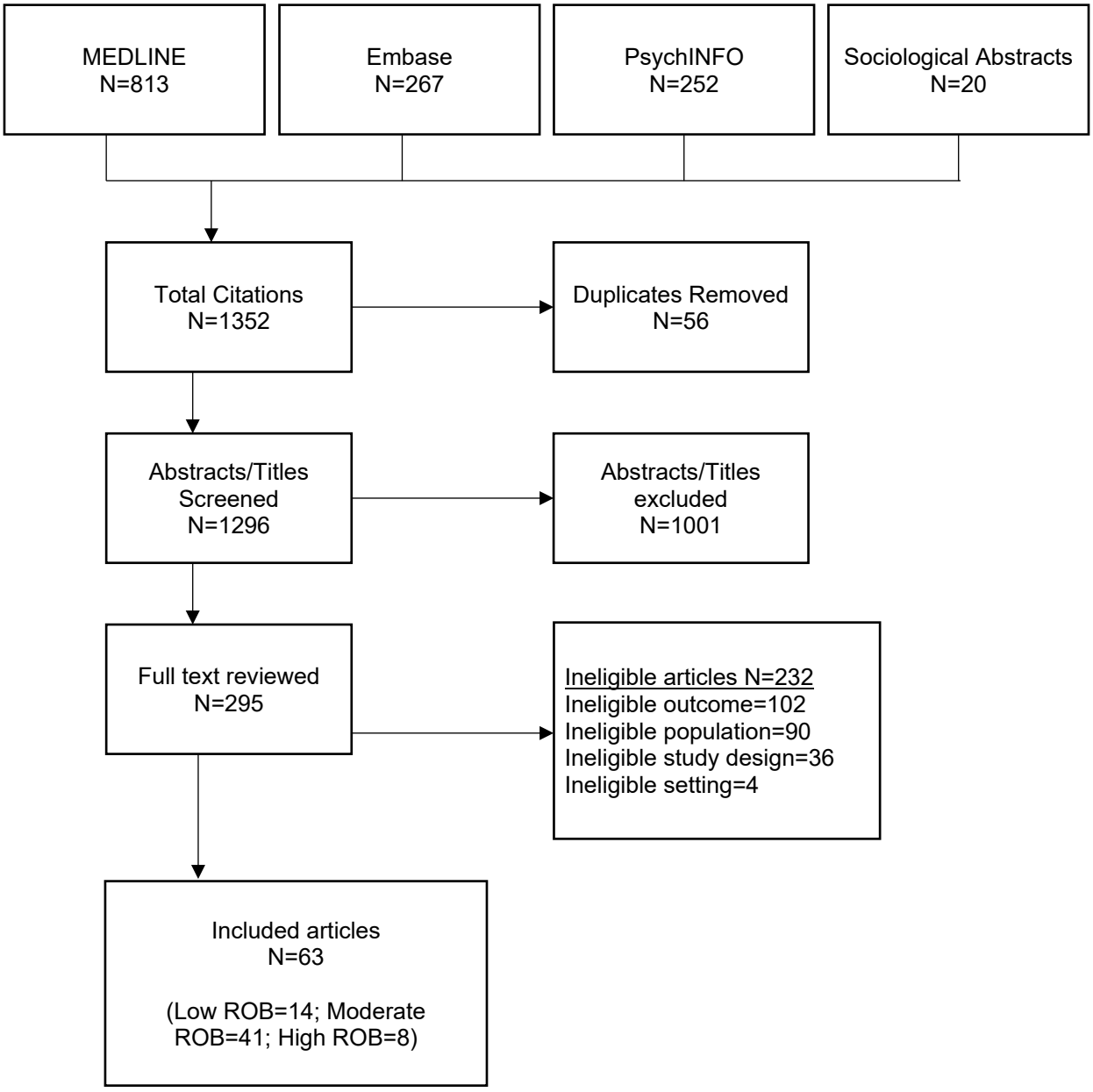


Table 3. Study Characteristics of All Eligible Studies

Study Characteristics	Risk of Bias			
	Low (k=14)	**Moderate** (k=41)	**High** (k=8)	**Total** (k=63)
Sample Size				
<1,000	0	3	5	8
1,000-9,999	1	5	1	7
10,000-99,999	1	11	0	12
≥100,000	12	22	2	36
Population				
Veteran	11	22	2	35
Active Military	5	20	6	31
Era of Service: Vietnam	1	1	0	2
Era of Service: OEF/OIF	6	8	2	16
Era of Service: Gulf War	0	2	0	2
Social-Ecologic Domains				
Individual	14	36	7	57
Relational	4	18	2	24
Community	0	3	0	4
Societal	0	0	0	0
Data Source				
VHA (administrative data)	10	18	0	28
DoD (administrative data)	7	21	4	32
VA/DoD SDR	1	4	0	5
STARRS	1	14	2	17
Survey/Self-Report	1	3	4	8
National Death Index	9	15	1	25
Claims Data (CMS/Tricare)	2	0	0	2
Other Military Data	4	6	0	10
National Violent Death Reporting System	0	1	1	2
Other Data Sources	0	2	0	2
Study Design				
Case-Control	0	7	3	10
Cross-Sectional	1	2	2	5
Prospective Cohort	2	4	1	7
Retrospective Cohort	11	28	2	41

CMS=Centers for Medicare/Medicaid Services; DoD=Department of Defense; OEF/OIF=Operation Enduring Freedom/Operation Iraqi Freedom; SDR=Suicide Data Repository; STARRS=Study to Assess Risk and Resilience in Servicemembers; VHA=Veterans Health Administration

OVERVIEW OF STUDIES RATED LOW OR MODERATE RISK OF BIAS

Key Messages

- The quality and quantity of information in Veterans and active duty military is limited, in part due to study design, multiplicity of reporting using similar data sources, variation in outcome reporting, inadequate adjustment for confounding factors, and possibly post-hoc analyses.
- The greatest amount of information is related to individual risk factors and comes from retrospective cohort studies, many of which have moderate risk of bias. No studies reported on societal level factors.
- Information from prospective cohort and low risk of bias studies among Veterans and active duty military suggests that individual level factors, such as a history of prior suicide ideation or attempts, mental illness (other than posttraumatic stress disorder), and substance, alcohol, or tobacco use are consistently predictive of, or associated with, suicide and attempts.
- Posttraumatic stress disorder, another individual level factor, was not consistently associated with suicide.
- Community level, relational level, and other individual level factors were reported in only 1 or 2 studies. These factors were sometimes associated with suicide and attempts, but the few studies limited confidence. Thus, further exploration of factors such as firearm status, marital status, and various forms of interpersonal violence is warranted.

Summary of Findings

Of the 55 studies rated low or moderate ROB, 50 reported on individual level factors, 22 reported on relational level factors, 3 reported on community level factors, and zero reported on societal level factors. Table 4 summarizes the number of studies which reported on risk or protective factors organized by the SEM. For many factors, results were informed by few studies with moderate ROB as details about factors used to control for potential confounding and determining the independent effect of the identified factors on deaths and attempts in the models, were difficult to adequately assess. Furthermore, there was little information regarding the selection of variables or thresholds used in the various models and whether the analyses were conceived a priori. Thus, assessing reported findings validity/reproducibility was problematic. Additional information on individual studies is included in Appendix B (ROB assessments) and Appendix D (evidence tables).

The most commonly reported factors at the individual level, in addition to demographic factors (age, race, sex, *etc*) and education were posttraumatic stress disorder (PTSD), other mental illnesses (*ie,* depression or anxiety), and alcohol, drug, or tobacco use (Table 4). Healthcare service use, criminal or legal problems, as well as military and deployment status, were also frequently noted. Firearm ownership and storage was only reported in 1 study despite firearms identified as a leading cause of suicide in Veterans. Ten studies explored the association of previous suicide attempt or ideation with future attempts or suicide.

At the relational level, marital status and relationship problems were most frequently reported.

Figure 3 further refines the identified risk/protective factors in a heat map stratified by study design. Individual risk factors were most frequently reported and consistently described across study design. The heat map also illustrates the limited amount of evidence from many of the reported factors even when looking across study design. Furthermore, as we describe the sections for the risk factor domains, many of the risk factors that we grouped in a single broad category (*eg*, alcohol, drug, or tobacco use) often used varying definitions or specific components of the category to assess the factor. Thus, the heat map provides an upper limit of the frequency and consistency of reporting across broad categories.

Table 5 provides the direction of the effect for each study which reported a risk or protective factor based on statistical significance as reported by study authors. Risk factors (*ie,* increased risk for suicide or attempt) are indicated as an upward arrow; protective factors (*ie,* decreased risk) are indicated as a downward arrow; and no association is indicated as horizontal double pointed arrowed. Individual results from each low risk of bias study are shown with blue arrows, moderate risk of bias in orange. Forty studies reported on suicides (4 prospective and 28 retrospective cohort studies) and 19 reported on attempts (3 prospective cohort, 13 retrospective cohort, and 3 case-control studies). While most studies reporting on a factor identified that factor as a risk rather than a protective factor, the findings were often from only 1 or 2 studies (and frequently using varying definitions of the factor. The figure illustrates the large identified gaps in evidence and the finding that most results were from moderate (rather than low) ROB studies. Results from each study that found "no effect" are shown with horizontal arrows without a discussion of the direction of the point estimate or the uncertainty that might be seen in the reported confidence intervals.

Table 4. Risk/Protective Factors Identified in Studies Rated Low/Moderate Risk of Bias (k=54)

Risk Factors	Number of Studies (k)
Individual Level	
Previous suicide attempt/suicidal ideation	10
Posttraumatic stress disorder	12
Other mental illness (*eg*, depression, anxiety, psychiatric conditions)	22
Emotions, such as anger, numbness, or hopelessness	4
Alcohol, tobacco, and/or drug use	17
Physical illness or pain	8
Sleep disorders	4
Cognitive or physical decline in functioning	3
Body mass index	2
Healthcare services use	10
Criminal or legal problems	7
Financial problems	2
Job problems or loss	5
Homelessness or housing instability	4
Life stressors (non-specific)	8
Firearm ownership/use/storage/accessibility	1

Demographics (*eg*, age, sex, race, education)	22
Sexual minority status	1
Transition from incarceration to civilian life	1
Military occupation	7
Military rank	9
Service connected (service-related disability)	2
Deployment status	14
Service branch	5
Service component	5
Time spent in service	9
Time deployed	3
Time since military separation	4
Military part-time vs full-time	1
Military former vs current service member	2
Relational Level	
Adverse childhood experiences	1
Bullying	1
Relationship problems (*eg*, break-up, violence, or loss)	9
Sexual violence	4
Marital status	12
Social isolation/perceived burdensomeness/thwarted belongingness	3
Death of a loved one or pet	1
Community Level	
Access to mental health care	0
Monthly IED rates	1
Military unit suicides	1
Military-related chemical exposures	1

Figure 3. Risk and Protective Factors for Suicide Deaths and Attempts, Stratified by Study Design

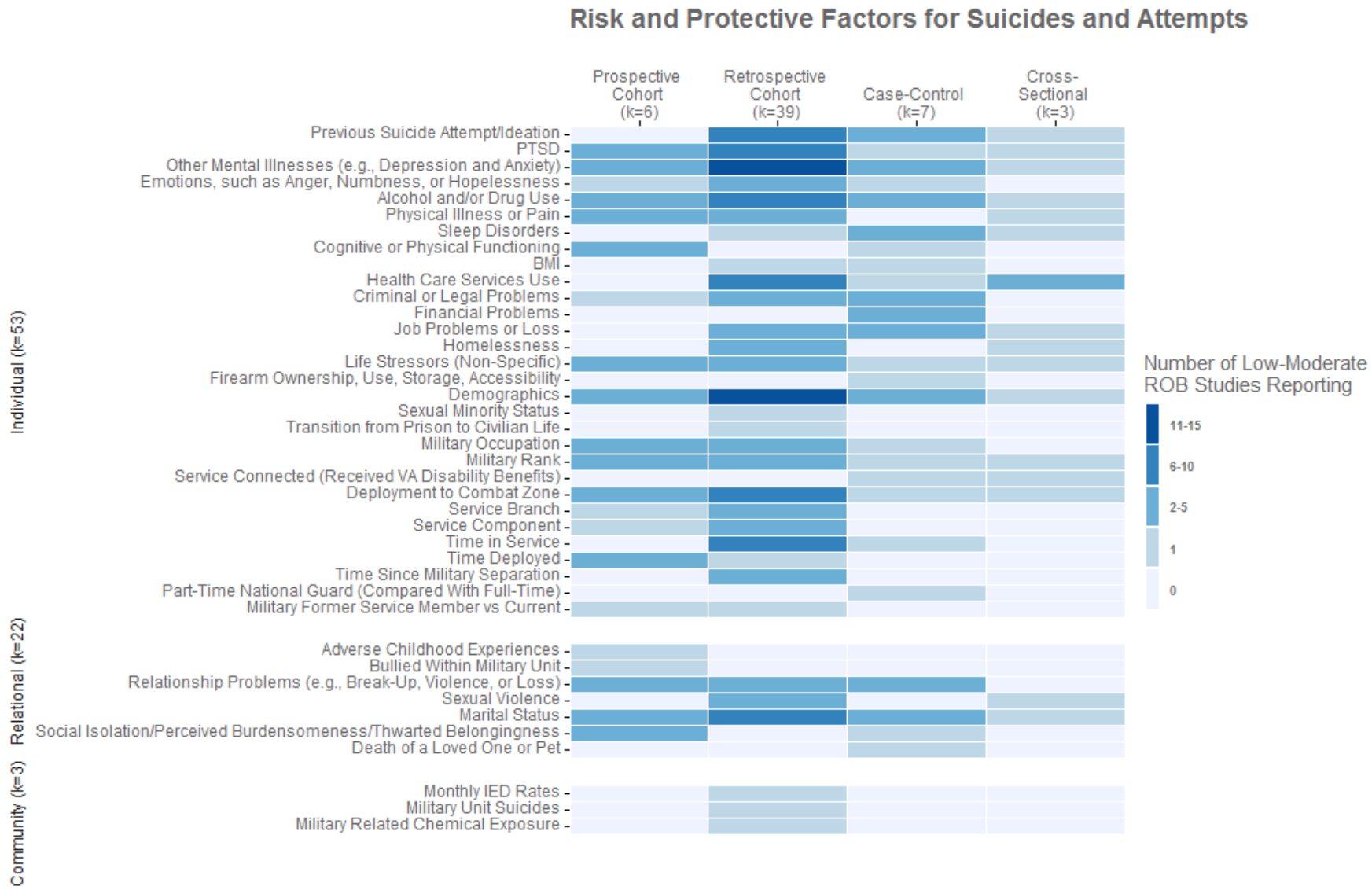


Table 5. Direction of Effect on Suicide Deaths and Attempts

Risk/Protective Factor		Prospective Cohort (k=6)		Retrospective Cohort (k=39)		Case-Control (k=7)		Cross-Sectional (k=3)	
		Deaths (k=4)	Attempts (k=3)	Deaths (k=28)	Attempts (k=13)	Deaths (k=6)	Attempts (k=3)	Deaths (k=3)	Attempts (k=0)
Individual (k=50)	Previous suicide attempt/ideation			↑↑↑↑	↑↑↑	↑ ↔↔	↑↑	↑	
	PTSD	↔↔		↑↑↑ ↓↓↓	↑↑↑		↑	↑	
	Other mental illnesses (*eg*, depression and anxiety)	↑↑	↔	↑↑↑↑↑↑ ↓	↑↑↑↑↑↑ ↔	↑↑↑↑	↑↑ ↔	↑	
	Emotions, such as anger, numbness, or hopelessness		↔	↑	↔	↔			
	Alcohol and/or drug use	↑↑↑		↑↑↑↑↑↑ ↔	↑↑ ↔	↑↑ ↔	↑↑↑	↑	
	Physical illness or pain	↑	↔	↑↑ ↓ ↔	↔			↑	
	Sleep disorders				↔	↔	↑	↑	
	Cognitive or physical decline in functioning	↑ ↔	↑			↑			
	BMI (overweight or obese)			↓			↓		

Risk/Protective Factor	Prospective Cohort (k=6)		Retrospective Cohort (k=39)		Case-Control (k=7)		Cross-Sectional (k=3)	
	Deaths (k=4)	Attempts (k=3)	Deaths (k=28)	Attempts (k=13)	Deaths (k=6)	Attempts (k=3)	Deaths (k=3)	Attempts (k=0)
Health care services use			↑↑↑ ↓ ↔	↑ ↔	↑		↑ ↓	
Criminal or legal problems		↑	↑ ↔	↑ ↔	↑ ↔↔	↔↔		
Financial problems					↔↔	↔		
Job problems or loss			↑	↑	↔↔	↔	↑	
Homelessness			↑↑ ↔	↑			↑	
Life stressors (non-specific)	↔	↔	↑↑	↑ ↔	↔		↑	
Firearm ownership, use, storage, accessibility					↑			
Sexual minority status			↑					
Transition from prison to civilian life			↔	↑				
Military rank (enlisted/lower rank)	↔	↔	↑↑ ↔	↑↑	↑		↑	
Service connected (received VA disability benefits)					↓		↑	

Risk/Protective Factor		Prospective Cohort (k=6)		Retrospective Cohort (k=39)		Case-Control (k=7)		Cross-Sectional (k=3)	
		Deaths (k=4)	Attempts (k=3)	Deaths (k=28)	Attempts (k=13)	Deaths (k=6)	Attempts (k=3)	Deaths (k=3)	Attempts (k=0)
	Service branch (Army/Marine)	↔		↑↑ ↔↔					
	Service component (active vs reserves)	↔		↑↑ ↔	↑				
	Less time in service			↑↑↑	↑↑↑↑↑	↑			
	Longer time or larger proportion of time deployed	↑ ↓			↑				
	Shorter time since military separation			↑↑↑ ↔					
	Part-time National Guard					↑			
	Military former service member vs current	↔		↑					
Relational (k=22)	Adverse childhood experiences	↑							
	Bullied within military unit		↑						
	Relationship problems (*eg*, break-up, violence, or loss)	↑	↔	↑	↑↑	↑↑↑ ↔	↑↑		
	Sexual violence			↑	↑ ↔			↑	

Risk/Protective Factor		Prospective Cohort (k=6)		Retrospective Cohort (k=39)		Case-Control (k=7)		Cross-Sectional (k=3)	
		Deaths (k=4)	Attempts (k=3)	Deaths (k=28)	Attempts (k=13)	Deaths (k=6)	Attempts (k=3)	Deaths (k=3)	Attempts (k=0)
	Marital status (unmarried)	↔↔		↑↑↑	↑↑ ↔↔↔	↔↔		↔	
	Social isolation/ perceived burdensomeness/ thwarted belongingness	↑	↔			↔			
	Death of a loved one or pet					↔			
Community (k=3)	Monthly IED rates				↑				
	Military unit suicides				↑				
	Military-related chemical exposure			↔					

BMI = Body mass index; IED= Improvised explosive devices; PTSD = Post traumatic stress disorder; VHA = Veterans Health Administration; VA = Department of Veterans Affairs

↑=increased risk
↓=decreased risk
↔=no difference or inconsistent
Blue=Low risk of bias study
Orange=Moderate risk of bias study

Notes: Each arrow represents results from a single study. Direction of effect based on reported p-values and confidence intervals. Across articles, there is overlap (to an unknown degree) in populations when the same administrative databases were used. Definitions of risk/protective factors across articles varied for several factors shown in table.
Demographics, military occupation, and deployment to combat zone are not shown in this table.

Individual Level

The Individual domain of the Social-Ecological Model consists of factors pertaining to personal characteristics, such as demographics, health, or attitudes.[5] We identified 50 studies that reported on individual risk factors. Of the 50 studies identified, 25 had a study population size ≥ 100,000, 30 captured the Veteran population, 25 made use of a VHA data source, and 29 made use of a DoD data source. Among the 50 studies that assessed individual risk or protective factors, 19 also assessed relational risk or protective factors and 3 evaluated community level risk or protective factors. These risk/protective factors were categorized into 26 subdomains which aligned with mental health conditions or health resource use, marital status, financial, legal or life/job stressors, or military service.

Among the identified 50 studies, 6 were of a prospective study design.[6-11] Of the 6 prospective cohort studies, 4 reported on suicides and 3 reported on attempts. Two of the 6 were rated low risk of bias, evaluated ≥ 100,000 individuals, and reported on suicides; neither reported attempts. One study focused on Veterans and used VHA medical records[7] while the other involved active duty military from Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) and used a variety of DoD data sources.[11]

All 4 moderate risk of bias studies evaluated active duty military personnel.

PTSD, other mental illnesses, and alcohol and/or drug use, as well as prior suicide attempts or ideation, were commonly reported as risk factors for both suicides and suicide attempts. The evidence identifying these variables as risk factors was generally consistent, primarily captured from retrospective or case-control studies, and found in both low and moderate risk of bias studies. PTSD was consistently shown to be a risk factor for suicide attempts, but results were inconsistent for suicide deaths.

Very few studies were prospective in nature with minimal overlap regarding the study risk factor of interest. Only the risk factors "other mental illness" and alcohol, tobacco, or drug use were evaluated by more than 1 prospective study and found to be a predictor of suicide. With little overlap of risk/protective factors between studies, there was less evidence to evaluate risk/protective factors on suicide attempts.

The evidence regarding other risk/protective factors, such as pain, healthcare service use, criminal or legal history, or financial or life stressors was sparse and less consistent across studies. Among the risk or protective factors related to the military, deployment status was captured by the largest number of studies, 14 in total. Military service variables such as less time in service and separation from service were also associated with both deaths and attempts. Increased body mass index (BMI) was determined to be a protective factor in 2 moderate risk of bias studies. Marital status (unmarried) was generally found to be a risk factor for suicide.

Housing instability (unstably housed and imminent risk for housing instability) was reported to increase risk of suicide death in 1 low ROB study.[30] Homelessness was found to increase risk of suicide deaths in 2 studies (both by the same author and rated moderate ROB),[63,64] while another low ROB study found no effect for suicide deaths, but an increase in suicide attempts.[27]

Two risk factors, military occupation and deployment status, were variably defined across the included studies. Seven studies describe an association between military occupation and suicide risk and 14 studies (low and moderate risk of bias) describe the association between deployment status and suicide risk (Appendix Table D2 and Appendix Table D3). Five of the studies investigating military occupation or job class used a version of combat occupation versus no-combat occupation; 2 of the 5 found no association and the remaining 3 found an increased risk of suicide[48] and increased risk of suicide attempt[23,33] for those with an occupational classification that included combat. The other 2 studies used very specific occupational titles; the first[47] found no association between job class and risk of death from suicide and the second[11] found a protective effect among those with a higher pay grade (E04-E07 vs E01-E03) and risk of death from suicide. Deployment status among the included studies referred to whether the individual had ever been deployed, was currently deployed, the number of deployments, whether the deployments had been to a combat region (OEF/OIF or Kosovo/Bosnia), or some combination of the previous categories. Three studies [23,24,32] investigated currently versus previously versus never deployed and suicide attempt risk. Never and previously deployed were found to be risk factors for suicide attempts but not currently deployed.

Relational Level

The Relational domain of the Social-Ecological Model contains direct person-to-person interaction, such as interpersonal relationships, social support, and family.[5] We identified 22 studies that reported on such factors; 18 were rated moderate ROB[6,8,9,12-26] and 4 were rated low ROB.[11,27,28,30] Studies reported a variety of factors at the relational level, including marital status, relationship problems, sexual violence, history of family violence, adverse childhood experiences, bullying within military unit, social isolation, perceived burdensomeness, thwarted belongingness, and death of a loved one or pet.

Several studies (k=12) reported on marital status, with most reporting no significant effect for suicidal behaviors (k=8[9,11,13,15,17,18,23,24]) and few (k=4[19,25,27,29]) reporting unmarried (single, widowed, divorced, separated, or never married) individuals were at increased risk for both suicides and attempts. Seven studies reported on relationship problems, including recently failed intimate relationships, and recent divorce or counseling. Five of these studies (including 2 low ROB) reported these factors increased risk for suicides and attempts,[11,16,17,22,28] while 2 reported no significant differences.[6,13]

Military sexual trauma was reported to increase risk for suicide death in 1 low ROB study.[30] Three moderate ROB studies also reported on sexual violence: 1 reporting military sexual trauma increased risk of suicides for both men and women,[20] the second reporting sexual assault victim status increased risk for suicide attempts,[21] and the third study found no significant effect of a history of sexual or physical abuse on suicide attempts.[14]

Two moderate ROB studies reported no significant increase in suicide risk for those reporting perceived burdensomeness,[8] thwarted belongingness,[8] or social isolation.[13] One low ROB study reported decreased social support increased risk of suicide.[11]

Two moderate ROB studies reported a history of family violence increased risk for suicide attempts.[23,26] One low ROB study reported an Adverse Childhood Experiences score of ≥ 4 increased risk for suicide as an adult.[11] One moderate ROB study reported that being bullied

within your military unit increased risk of suicide attempts.[6] One moderate ROB study reported no significant increase in risk of suicide behavior for those suffering from grief or loss of a loved one or pet.[13]

Community Level

The Community domain of the Social-Ecological Model contains factors which are bounded to a certain region or area, like neighborhoods, schools, or workplaces.[5] We identified 3 studies which reported on factors in this domain; all rated moderate ROB.[31-33] All 3 studies reported on military-related factors: monthly improvised explosive device rates, unit suicides, and exposure to nerve gas.

Two studies used data from STARRS, the first reported that an increase in the frequency of monthly improvised explosive device incidents (as measured by the Joint IED Defeat Organization) increased risk for suicide attempts (moderate ROB),[32] and the second reported as the number of suicide attempts in a military unit increased, so did individual risk for suicide attempt (moderate ROB).[33]

One moderate ROB study[31] found no significant effects of nerve gas exposure on risk of suicide deaths.

Societal Level

The Societal domain of the Social-Ecological Model contains large-scale issues such as social and cultural norms, policies, or other guiding rules and laws.[5] Our review did not identify any studies which met our inclusion criteria that reported on these factors.

Summary of Findings from Prospective Cohort Studies

We summarize findings from the 6 prospective cohort studies[6-11] because their prospective design generally provides more reliable information on whether assessed factors are predictive of suicide rather than merely associated with suicide (Table 6). Overall, 4 studies reported on suicide and 3 reported on suicide attempts. One of these studies reported on both suicides and attempts.[10] Two were considered low ROB and both reported on suicides (1 in Veterans[7] and 1 in active military[11]). Of the 4 reports evaluating suicide, only 2 assessed more than a single predictive factor.[9,11] The other 2, Bohnert[7] and Naifeh,[10] assessed the role of tobacco use in Veterans and cognitive decline in active military members, respectively. Three reports used data from the STARRS database and all were considered moderate ROB.[6,8,10] The only prospective cohort study that utilized STARRS data to assess suicides was by Naifeh et al.[10] No prospective cohort studies reported on either community or societal level factors.

Both low ROB studies with a prospective study design assessed the role of tobacco use on suicides and found an increased risk when controlling for other factors.[7,11] Bohnert[7] made use of VHA electronic medical record information and only assessed the predictive effect of tobacco use on suicide. They found that a diagnosis of tobacco use disorder was associated with suicides among Veterans when controlling for age group, sex, Charlson comorbidity score, VHA service connection, substance use disorder, bipolar disorder, depression, other anxiety disorder, posttraumatic stress disorder, and schizophrenia. Philipps[11] and colleagues evaluated tobacco and other drug use in OEF/OIF Active Military individuals as part of the Recruit Assessment

Program study. However, only alcohol use was reported in models that adjusted for other confounding factors (depression, PTSD, adjustment disorder, and deployment). One moderate ROB study using data from the Millennium Cohort Study[34] reported alcohol use, defined as heavy/binge drinking or alcohol-related problems identified on a screening question, was positively associated with suicides.[9]

The low ROB prospective study conducted in active duty military[11] noted a number of risk factors predictive of suicide including: mental illness, history of traumatic brain injury (TBI), lack of high school education, the percentage of time deployed while in the military, and military occupation. OEF/OIF deployment was a protective factor against suicide, while a history of PTSD was not significantly associated with suicide (similarly reported in 1 other moderate ROB prospective cohort study[9]). In contrast, the number of deployments was positively associated with suicide attempts in a single moderate risk of bias study among active duty military.[6]

Table 6. Findings from Prospective Cohort Studies [a, b]

Risk/ Protective Factor		Author, Publication Year, Population, Sample Size, Cohort Name											
		Bernecker 2019[6] Active Military N: 10,000-99,999 STARRS		**Bohnert 2014[7]** Veteran N: ≥ 100,000 VHA		**Chu 2020[8]** Active Military N: 1,000-9,999 STARRS		**LeardMann 2013[9]** Veteran and Active Military N: ≥ 100,000 Millennium Cohort Study		**Naifeh 2017[10]** Active Military N: 10,000-99,999 STARRS		**Phillips 2017[11]** Active Military N: ≥ 100,000 Recruit Assess Program	
		SD	SA	SD	SA	SD	SA	SD	SA	SD	SA	SD	SA
Individual	PTSD							↔				↔	
	Other mental illnesses (*eg*, anxiety, depression)		↔					↑				↑	
	Hopelessness						↔						
	Alcohol, tobacco, or other drug use			↑				↑				↑	
	Physical illness or pain		↔									↑	
	Cognitive or physical decline in functioning							↔		↑	↑		
	Criminal or legal problems		↑										
	Life stressors (non-specific)		↔					↔					
	Military rank (enlisted vs officer)		↔					↔					
	Service branch (Army/Marine)							↔					
	Service component (active vs reserves)							↔					
	Longer time or larger proportion of time deployed							↓				↑	
	Military former vs current service member							↔					
Relational	Adverse childhood experiences											↑	
	Bullied within military unit		↑										
	Relationship problems		↔									↑	
	Marital status [c]							↔				↔	
	Social isolation/ perceived burdensomeness/ thwarted belongingness						↔					↑	

SA = suicide attempts; SD = suicide deaths; STARRS = Army Study to Assess Risk and Resilience in Servicemembers

↑=increased risk
↓=decreased risk
↔=no difference or inconsistent
Low risk of bias study
Moderate risk of bias study

a Demographics, including education are not shown in this table.
b Military occupation and deployment status can be found in appendix tables.
c The 2 studies measuring marital status used different definitions. LeardMann et al evaluated not married relative to married. Phillips et al analyzed marital status during in-service and re-captured at later date. Phillips et al. also assessed whether individuals had received relationship counseling.

Summary of Findings from Low Risk of Bias Studies

We identified 12 retrospective studies in addition to the 2 prospective cohort studies that were rated low ROB (14 total) and thus provide additional information. As summarized in Table 3, 12 studies involved more than 100,000 individuals, 11 studies enrolled Veterans, and 5 included active duty military. Individual factors were reported in 14 studies, and relational factors were reported in 4 studies. No studies reported on community or societal factors. All studies reported on suicides and 2 reported on attempts.

While 14 studies reported on individual risk factors, each unique risk factor was typically assessed in only 1 or 2 studies. The following risk factors were assessed in 3 or more low ROB studies: previous suicide ideation or attempts, mental illness, PTSD, and alcohol, drug, or tobacco use. Suicide ideation or previous attempts were positively associated with suicide in 3 retrospective studies, 2 in Veterans and 1 in active military.[27,28,35] A history of mental illness was consistently associated with suicide in 4 studies (3 in Veterans and 1 in active military.[27,28,35,36] In 4 of 5 retrospective studies, substance use disorder was associated with increased suicides, and in the 2 prospective studies tobacco use was also associated with increased suicide risk in both Veterans and active military. The effect of PTSD on suicides was inconsistent. Two retrospective studies found a positive association while 1 found a protective effect, and the single prospective study[11] found no significant relationship with PTSD and subsequent suicide among active military.

Of the 4 low ROB studies reporting on relational factors, 2 were retrospective cohort studies, 1 cross-sectional, and 1 prospective cohort. One study in Veterans noted that Veterans who were divorced, widowed, or never married had an increased suicide risk compared to married individuals.[27] Similarly, the report by Shen and colleagues[28] also showed that being divorced was associated with an increased risk of suicide. Cusack et al reported that a history of military sexual trauma increased risk for suicide deaths.[30] As noted above, Phillips[11] was a prospective cohort study in active duty military. They found that adverse childhood experiences, relationship problems, and social isolation were associated with increased suicide while marital status had no significant association.

SUMMARY AND DISCUSSION

We conducted a systematic review and prepared a corresponding evidence map on the social-ecological risk and protective factors for suicide and suicide attempts among Veterans and active military.

We identified 55 studies rated as either low or moderate risk of bias published since 2011. Six were prospective studies with 4 (2 low risk of bias) examining risk factors for suicide deaths. Based on the available evidence we found that: 1) the quality and quantity of information was limited due in part to study design, multiplicity of reporting using similar data sources, variation in outcome reporting, potential lack of adequate adjustment for confounding factors, and possibly results-driven reporting; 2) the greatest amount of information was related to individual risk factors and came from retrospective cohort studies, many of which had moderate risk of bias; 3) information from prospective cohort and low risk of bias studies suggested that a history of prior suicide ideation or attempts, mental illness (not including PTSD), and substance, alcohol, or tobacco use are consistently predictive of, or associated with, suicide and attempts; 4) PTSD, unlike depression, anxiety, and other common mental disorders studied, was not consistently associated with suicide; 5) from the relational domain, marital status was not consistently associated with suicide or attempts, while relationship difficulties were generally found to be risk factors; 6) community level, relational level, and other individual level factors were reported in only 1 or 2 studies. These factors were sometimes associated with suicide and attempts, but the few studies limited confidence. Thus, further exploration of factors such as firearm status, marital status, and various forms of interpersonal violence is warranted; and 7) no studies reported on societal level factors.

Our report updates and expands on previous reviews evaluating suicide predictors in Veterans and active duty military.[37,38] These reviews included literature published prior to 2011 and 2015 respectively, evaluated demographic and clinical factors, mainly included studies of individuals at known high risk, primarily described “risk prediction tools” used and their accuracy in these populations, and did not use the CDC Social-Ecological Model to evaluate studies and summarize results.

We urge caution in the interpretation and application of our findings. This report was intended as an evidence map of risk and protective factors using the Social-Ecological Model, which has utility for learning where research is concentrated and gaps that need to be addressed. We limited studies to those evaluating general populations of Veterans or active duty military not at otherwise known increased risk for suicide. Studies in other populations may also be informative, including general community populations and high-risk clinical samples. The factors assessed and categories used to assess risk domains often varied considerably in their definition. Findings were infrequently reported in more than 1 study, and when reported by multiple studies, factors were often defined differently. Consensus around which risk factors to include and their measurement has the potential to increase comparability of findings across studies and advance the field. The models used to assess the independence of reported factors also varied and there remains a high potential that unmeasured confounders are explanatory. Additionally, results could be dependent on thresholds or methods used to define the factor or the variables controlled. Reported results may either be due to chance or lack of power. There is a limited body of research examining multiple factors and their potential additive or non-additive

influence of suicide and attempts. Positive associations from studies other than prospective designs may be merely associations rather than prognostic risk or protective factors. Furthermore, for most identified risk factors the defined risk estimates were relatively modest. Suicide is a rare event in the general population (even among Veterans and active duty military). Therefore, implementing these findings in individuals may unnecessarily label many at increased risk or result in program development to mitigate risk in identified individuals that could be resource-intensive, burdensome, and costly, and result in harms from overdiagnosis and labeling of individuals who would never attempt or die by suicide.

LIMITATIONS

Due to the heterogeneity of identified studies and the large number and variation in reporting of risk and protective factors, we prepared a systematic review and evidence map rather than a quantitative synthesis of results or detailed analyses of individual studies. We did, however, provide information on directionality of effect and reported on study design, risk of bias, and analytic methods, thus enriching the information available typically shown in evidence maps.

Evidence maps identify gaps in knowledge and/or future research needs and present results, often in figures or graphs, or as a searchable database.[40] Evidence maps may serve as a first step to a systematic review to identify gaps in a topic area. We identified many gaps in the quantity and quality of evidence that limits our ability to draw conclusions and provide immediate policy/practice considerations.

There were only 2 low risk of bias prospective studies specifically designed to address the key questions or risk factors. Inclusion of low risk of bias retrospective studies provides additional information but prognostic effects of evaluated factors cannot be inferred from retrospective data. Even when including lower methodologic quality studies, individual risk/protective factor results were informed by few studies. The details regarding variable inclusion in analytic models to control for potential confounding and determine the independent effect of reported factors on deaths and attempts varied and were difficult to adequately assess. There was little information regarding the conceptual frameworks used to select variables or thresholds used in the various models and whether the analyses were conceived of *a priori*. Many studies were derived from the same databases and thus are unlikely to be truly independent regarding their findings. We based our assessment of whether a factor was a risk or protective factor solely on the author-defined statistical significance of their findings. It is possible that some statistically significant results were due to chance or data-driven analyses or were very small in magnitude while some statistically nonsignificant results were due to poor statistical power and accompanying wide confidence intervals that could miss potentially clinically important findings.

Finally, available information generally infers associations rather than prognosis of factors with suicide or attempts. Consensus was reached in consultation with our partners and technical expert panel members on how to broadly categorize various factors and their domains. Authors used varying definitions of risk and protective factors. We attempted to discuss the specific factors used in each of the domains, especially when describing prospective cohort and low risk of bias studies, as results may vary due to variations in the factors or definition of given factor included in the specific domain. It is possible that different interpretations or categorizations may result in differing perspectives on our evidence map. In summary, our ability to reliably assess reported findings/validity/reproducibility was problematic.

Study Quality

In general, the methodological quality of included studies was limited. Only 13 studies were assessed to be low risk of bias and only 6 were designed prospectively. Multiple reports used the same or similar databases for their analyses and thus findings are likely limited in their independent assessment or reproducibility. Furthermore, authors did not fully describe the models used to assess the independent risk or protective effect. There are no well-established analytic models or confounding factors of interest to control for in analytic models. Additionally, it is not clear why certain thresholds or variables were used or whether results were data rather than hypotheses driven. It is not known whether authors adequately adjusted for confounders, if analyses were post-hoc/data driven, or whether negative results were not consistently reported.

Heterogeneity

We created an evidence map to summarize findings across study design, methodological quality and outcomes reported. We also summarize the populations assessed including Veteran versus active duty military and time in service. Rather than pooling results we describe results across study design and risk of bias. We described results separately for prospective cohort studies and for any study rated as low risk of bias. Therefore, readers can focus on the results presentation of this report that are most useful for them: *eg*, according to study population (Veteran or active duty); risk factor domain (individual, relational, community); study design (prospective, retrospective…); risk of bias (low vs low plus moderate). However, the results are already limited and additional attempts to determine whether findings were consistent or varied across other subgroups was not methodologically useful.

Applicability of Findings to the VA Population

Our findings are highly applicable to the VA population. We targeted inclusion to studies of US Veterans or active duty military. We excluded studies only reporting individuals known to be at increased suicidal risk, typically due to mental health concerns or prior suicide attempts.

RESEARCH GAPS/FUTURE RESEARCH

The currently available evidence is perhaps most notable for its limitations, gaps, and difficulty and thus emphasizes the need for future research in the areas of social-ecological factors for suicide. Because suicide is fortunately a rare event, assessing prognostic factors in those not known to be at markedly elevated risk requires very large sample sizes and long follow-up. Additionally, interventions known to reduce suicide risk or alter known risk factors may differentially affect suicide and attempts, thus making study of unknown factors difficult. However, given the large individual and societal impact of suicides and attempts research to determine risk and protective factors and develop strategies to mitigate these events is valuable. Additional creation of large cohorts to prospectively collect data specifically targeted to potential social-ecologic factors in general populations or those not to be at known marked increased risk based on sociodemographic, race/ethnicity, age, or sex would be useful. Utilization of large administrative/clinical data sets is helpful for efficiently collecting data on clinical diagnoses, healthcare service use, and other centrally collected health information. However, additional, more granular information related to community, relational, societal, and individual levels will likely require innovative survey methods. The current social-ecological model is useful for conceptualizing broad domains. Our attempt at categorizing identified factors into these domains

and then subdomains is 1 possible strategy for exploring factors. Additional research is needed to better identify factor classification and definitions used to categorize and standardize factor reporting. More refined analytic methods to adjust for known and potential confounders is important and would lead to a better understanding of whether results are due to exploratory analyses, chance, or limited statistical power. Additional work is needed to validate and harmonize how factors and confounders are operationalized, measured, and reported, as well as the analytic models used.

CONCLUSIONS

This systematic review and accompanying evidence map highlights main areas of information as well as gaps in the evidence according to study design and potential prognostic factors across the Social-Ecological Model among general populations of Veterans and active duty military. What information does exist is mainly from moderate risk of bias retrospective studies and describes risk factors within the social-ecological individual domain. Individual level social-ecological domain factors, especially mental illnesses and alcohol, drug, or tobacco use, as well as prior suicide attempts or ideation, may be the best currently supported risk factors for suicide and attempts. Information on military traumas and sexual or family violence generally showed positive associations with suicide. There were no data on societal level factors. There was little information regarding factors protective against suicide. Risk factor definitions and analyses varied considerably across reports and many were derived from multiple publications involving similar population databases. Standardization of risk factor definitions and comprehensive adjustments for potential confounding variables would aid our understanding of the association between these factors and suicidality, both individually and in concert with other factors.

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