Epidemiologic Approaches to Veterans’ Health

J. Michael Gaziano*, John Concato, Sandro Galea, Nicholas L. Smith, and Dawn Provenzale

* Correspondence to Dr. J. Michael Gaziano, Massachusetts Veterans Epidemiology Research and Information Center, 150 South Huntington Avenue, Jamaica Plain, MA 02130 (e-mail: michael.gaziano@va.gov).

The present issue of Epidemiologic Reviews is dedicated to better understanding the health of men and women who have served in the military. There are 13 articles that discuss a range of physical and mental health concerns among both military personnel who are currently serving and those who served in the past. The corresponding research provides insight into issues that are directly relevant and of keen interest to clinicians and investigators. The articles illustrate some of the obstacles to conducting rigorous epidemiologic research when seeking to inform the health issues of those who serve in the military and of veterans. Within the United States, they point to opportunities for the Department of Defense and Department of Veterans Affairs (VA) to address existing gaps in knowledge. The VA in particular can take advantage of its research infrastructure, altruistic veteran population, and clinical and administrative databases. In the era of multinational military interventions, international counterparts of the Department of Defense and VA should collaborate in the collection of data on relevant military exposures and also in the characterization of short- and long-term health effects related to service to better inform health needs. The work included in this issue is a call to the global research community to continue to invest resources to better characterize military service and its impact on health. Finally, these articles serve as a testament to the additional health burden carried by many of the women and men who have provided service to their country.

Abbreviations: HCV, hepatitis C virus; VA, Department of Veterans Affairs; VHA, Veterans Health Administration.

The current issue of Epidemiologic Reviews is dedicated to better understanding the health of the men and women who have provided service to national armed forces by synthesizing data from scores of published epidemiologic research studies. Included are 13 articles covering a range of physical and mental health concerns among those currently serving and also among those who completed their service. Although many of the articles address the health concerns of recent eras involving Iraq and Afghanistan, others are more far reaching and include conflict eras from decades past. To facilitate an overview, we have grouped the studies on themes related to mental health generally and to the impact of service and deployment on physical and behavioral health.

MENTAL HEALTH

Four articles in this issue focus on specific mental health topics affecting active-duty military and veterans: general mental health, post-traumatic stress disorder, and stigma of mental health impact on seeking care. All are reviews of the medical literature, and all examine specific issues that are arguably understudied. These articles are an important contribution to the field—both by bringing attention to particular problems and by highlighting areas for future research.

Cohen et al. (1) sought to identify incidence and prevalence estimates among reserve component forces, compare those estimates with those among active-duty forces, and document drivers of psychiatric burden among reserve component forces. An understanding of this research should recognize the impact of the Total Force Policy enacted in 1973 (2), based on experiences during the Vietnam War combined with the changeover to an all-volunteer military force. The Policy (modified several times subsequently) has had an overall impact of increasing responsibilities for Army and Air National Guardsmen, as well as for members of the Army, Navy, Marine, Air Force, and Coast Guard Reserves. For example, approximately 40% of deployed service members during the height of Operation Iraqi Freedom/Operation Enduring Freedom were from the reserve component (3). With distinct challenges both during and after deployment, the health of such “citizen soldiers” warrants attention alongside studies of their active-duty counterparts.

Among 751 potentially relevant articles, 27 met the inclusion criteria of Cohen et al. (1). Given the variability across patient populations and methods of each article retrieved, the authors found substantial heterogeneity in prevalence estimates reported by reserve component forces. Representative results include a higher prevalence of alcohol use disorders,
but not depression or post-traumatic stress disorder, among reserve component compared with active-duty forces. In addition, specific risk factors for mental health disorders were found in pre-, peri-, and postdeployment periods, suggesting potential prevention and treatment strategies. The authors correctly point out that changing definitions and diagnostic criteria are challenges when conducting research; the choice of diagnostic tools is another methodological consideration.

Blodgett et al. (4) examined the literature for articles on justice-involved veterans, seeking reports of trauma history as well as diagnoses of post-traumatic stress disorder, substance use disorders, mood disorders, personality disorders, and suicidality. The study also compared justice-involved veterans with other (nonveteran) justice-involved adults and with other (non–justice-involved) veterans. An appreciation of this research should recognize that, in the United States, approximately 10% of incarcerated adults had served previously in the military and that 100,000–200,000 veterans are currently in jail or prison annually (5). Yet, in the spectrum of attention given to the health of military personnel ranging from positive stories of heroism during combat to negative reports of diseases and disorders among returning service members, the plight of justice-involved veterans is often just a footnote.

In addition to 14 publications meeting study criteria, Blodgett et al. (4) obtained Department of Veterans Affairs (VA) administrative data from the Veterans Justice Outreach Program and the Health Care for Reentry Veterans Program. Overall, with an average age in the 40s and with very few women, the results found substantial heterogeneity regarding the prevalence of mental health disorders across studies. In addition, disorders among justice-involved veterans were found to be more prevalent when compared with nonveterans in prisons or jails and also when compared with non–justice-involved veterans. This work also highlights issues such as previous trauma, as well as the appropriate assessment and treatment of veterans with mental health–related conditions. The role of VA benefits is also pertinent, whether for medical conditions, to address related problems such as homelessness, or specifically for veterans experiencing legal problems.

Sharp et al. (6) appraised articles involving the potential stigma associated with seeking or receiving mental health care. This review of 20 articles generated weighted prevalence estimates for individual items on a scale for measuring anticipated stigma, ranging from a minimum of 25.5% endorsing “my leaders would blame me for the problem” (6, p. 151) to a maximum of 44.2% endorsing “my unit leadership might treat me differently” (6, p. 144). No clear association was found between attitudes toward stigma and the propensity to seek or to actually receive mental health care. Methodological issues included the need for researchers to consider various categories of stigma, including (anticipated and) public and internalized stigma.

Hall et al. (7) produced a “narrative review” of articles addressing the overlap between post-traumatic stress disorder and either physical activity or eating disorders. This work was motivated by the established role of exercise and diet as predictors of morbidity and mortality, linked to ongoing assessments of possible associations between post-traumatic stress disorder and cardiovascular or metabolic factors. The search strategy yielded 15 articles related to physical activity and 10 articles related to eating behaviors. Of note, a paucity of articles involving veterans prompted the authors to conduct a review of articles including nonveterans. As a status report on this topic, the authors found “considerable heterogeneity in the study designs and sample populations, and many of the studies had methodological and reporting limitations” (7, p. 103).

Taken together, the 4 mental health articles highlight important gaps in knowledge involving the health of, and health care for, veterans. A common theme was the heterogeneity of patient populations, leading to highly variable estimates. In addition, substantial variability was found regarding the methods for conducting patient-oriented research, even when focusing on very specific topics.

**IMPACT OF SERVICE AND DEPLOYMENT ON PHYSICAL HEALTH**

Many of the reviews in this issue address the impact of deployment to combat zones on the subsequent health of service members. Although the often grim aftermath of war on the physical and mental health of men and women who served has been known for generations, there has been a marked growth in the past decade of scholarly publications that address the impact on health. In this section, contributing authors provide a systematic review of the impact of military service in and deployment to wars in Southwest and Southeast Asia, including Kuwait, Iraq, Afghanistan, and Vietnam, on sensory (hearing) impairment, degenerative disease (amyotrophic lateral sclerosis), physical function (respiratory symptoms), and hepatitis C infection.

In the review by Theodoroff et al. (8), 14 scholarly publications were synthesized to characterize the prevalence of and risk factors for hearing loss and tinnitus in US veterans and military personnel from the recent Iraq and Afghanistan wars. The review is a follow-up to the 2006 Institute of Medicine report, which documented the prevalence and intensity of deafening noise in many military settings but not specifically to deployment (9). Among veterans of the Iraq and Afghanistan wars, Theodoroff et al. estimate the prevalence of hearing problems to range from 7% to 27%, with about 2% experiencing hearing loss. Tinnitus was more common, with a prevalence of 31%. For service members with deployment-related blast exposures, the prevalence was disturbingly high for both hearing impairment and tinnitus. Beyond noise-related risk factors, little is known about other factors that might influence hearing impairment in this population. Further, the impact of hearing loss on the quality of life has not been characterized. As is seen with other reviews in this issue, contributing authors had concerns about the representativeness of the data, given that most studies in the meta-analysis represent a subset of veterans seeking treatment. The authors also point out that low levels of hearing impairment, especially in young veterans, are not reflected in current classifications of impairment so that the extent of clinical hearing deficits attributable to military exposures may be systematically deflated.

In the review by Falvo et al. (10), the authors addressed another environmental exposure, airborne pollutants. Synthesizing data from 19 publications addressing military deployment in Iraq and Afghanistan since 2001, Falvo et al. provide a summary of what is currently known about the impact of service...
on respiratory symptoms, illnesses, and disease. Studies of airborne pollutants convincingly associate these exposures with an increased burden of acute respiratory illness, but the data addressing nonacute health effects on function provide inconclusive results primarily because of the nonrepresentative sample of the study populations. The data associating airborne exposures to respiratory disease are similarly inconclusive, and no data are available to evaluate lung function and structure in those deployed compared with those not deployed.

In the review by Beard and Kamel (11), the authors addressed a less obvious outcome associated with military and deployment exposures, the onset of amyotrophic lateral sclerosis. Like the study by Theodoroff et al., this review is a follow-up to an Institute of Medicine report from 2006 that concluded there was "limited and suggestive evidence" of a causal association (12, p. 56). Culling and synthesizing findings from 30 publications, Beard and Kamel expand upon the Institute of Medicine findings, providing further insights to potential military exposures that may lead to amyotrophic lateral sclerosis development and its impact on survival. Limitations of the available studies, including deficiencies in exposure ascertainment and power, prevented the authors from identifying military-specific causal factors.

The final article by Beste and Ioannou (13) discusses the prevalence and treatment of chronic hepatitis C virus in those that receive their care at the VA. The article summarizes 28 articles on the prevalence and treatment for hepatitis C infection and highlights the increased prevalence of hepatitis C among veteran users of the VA health-care system, focusing on the Vietnam-era cohort as the group with the highest infection rate in the Veterans Health Administration (VHA). The prevalence of hepatitis C virus (HCV) is estimated at 3.2%–5.4% of users of the VA health-care system with another 20% who are not yet diagnosed. In contrast, the prevalence of HCV in the US population in the same time period has been estimated at 1.6%. Veterans who seek VA care are likely nonrepresentative of the veteran population in the United States, and the risk factors for HCV infection are overrepresented in VA users. Two National Health and Nutrition Examination Survey (NHANES)–based studies cited by the authors did not find an increased prevalence of HCV in a representative sample of veterans compared with nonveterans. The authors discuss traditional risk factors for HCV infection, including drug use, transfusion of blood products before 1992, intranasal cocaine use, male-to-male sex, and body tattoos. Although there has been a concern that military exposures in Vietnam, including air gun injectors and exposure to blood during combat, were associated with the high prevalence of HCV among VA users, the authors summarize data that suggest that the rates of standard risk factors for HCV infection are similar in Vietnam veterans and nonveterans that are cared for in non-VA facilities. The authors also report on challenges associated with treatment in VA patients, including ineligibility due to comorbidities, poor response rate, and adverse effects leading to early termination of therapy. Therapy has been associated with lower all-cause mortality in those who achieve successful viral eradication. This is important and particularly relevant to veterans as new therapies emerge that may require shorter treatment periods, have fewer adverse effects, and may be used in those with the significant comorbidity burden of the veteran patient population. Future studies should focus on the impact of the newer antiviral drugs and their costs, as well as on treatment and outcomes for VA patients with HCV. In summary, the articles in this section highlight the challenges that veterans face after military service and identify future areas for research to improve their health and the care they receive.

**IMPACT OF SERVICE AND DEPLOYMENT ON BEHAVIORAL HEALTH**

Five manuscripts in this issue address the association between aspects of military service and health behaviors including alcohol and substance abuse, aggressive behavior, smoking and pain, and homelessness, a serious social problem that is a result of and impacts behavioral, mental, and physical health.

In the article by MacManus et al. (14), the authors provide insight into a longstanding observation that service members returning from war may bring home with them more violent tendencies than they had before leaving. The authors conducted a systematic review of 17 studies and additional meta-analyses of 10 to examine the association of postdeployment violent and aggressive behaviors in military personnel with deployment and combat exposures from the United States and the United Kingdom. The prevalence of aggressive behaviors was 36% and ranged from 23% to 67% depending on the study population and definition of what constituted a violent behavior. When compared with service members not exposed to combat, those exposed had 3 times the odds of the adverse behaviors, a strongly significant finding. Although the authors describe the limitations of their approach, including no baseline measures of violent behavior, their findings are nonetheless unsettling.

Two articles address alcohol and substance abuse, both generally and among women. In the review by Kelsall et al. (15), the authors investigate the impact of military service on alcohol and substance abuse among service members who served in the Gulf, Afghanistan, and Iraq wars. For alcohol abuse, deployment compared with nondeployment was associated with 30%–40% increases in the risk, an estimate that was similar across the different wars. For substance abuse, estimates were more variable but nonetheless indicated an increase in risk in the range of 15%–35%.

The article by Hoggatt et al. (16) is a systematic review of substance misuse, abuse, or dependence in US women veterans, including National Guard and reserve members. The authors reviewed the literature on these disorders in women who use the VHA for their medical care. Of the 837 articles identified, 56 met the inclusion criteria for review. Their goal was to describe published estimates for rates of substance misuse in women veterans, compare their rates with those of civilian women and veteran men, and describe types of trauma exposures and simultaneously occurring conditions that distinguish women veterans with and without substance misuse. They also sought to examine how substance misuse and comorbidity rate estimates vary depending on the subgroup studies, source of data, and method of assessment. Representative results include reported rates of alcohol misuse ranging from 12% to 37%, based on an Alcohol Use Disorders Identification Test–Clinicians (AUDIT-C) score of 3 or greater. Rates of alcohol abuse or dependence in the past year.
were 3%–10%; diagnosed drug use or dependence or other nonalcohol drug misuse, 1%–6%; and diagnosed substance use disorders, 3%–16%. Few studies compared women veterans and civilians directly, but similar rates of binge and heavy drinking were found; substance use disorders were generally higher in men. In addition, substance misuse was associated with increased mortality and suicide rates among women veterans. The authors noted that studies focusing on Operation Enduring Freedom/Operation Iraqi Freedom veterans generally reported higher rates of substance misuse, and rates of substance misuse in women veterans were higher in studies using gender-tailed criteria to define these outcomes. The authors identified important gaps in the medical literature including that the data were limited, with their review reflecting only 33 data sets. Most studies included only VA patients with data subject to variations in diagnostic practices and reporting on the part of providers. Studies that directly surveyed patients were generally smaller, with reduced generalizability due to selection bias, study inclusion criteria, and unintentionally low participation rates. There were no studies with direct comparisons between women who use the VHA for their health care and those who do not. Thus, the reports summarized in this article are likely to underestimate the true prevalence of these disorders in women veterans.

The next article by Chapman and Wu (17) in this section highlights the association between cigarette smoking and pain among veterans. The authors reviewed 23 articles that reported on pain and smoking in veterans or the military population. The authors noted that chronic pain and cigarette use are both common in US veterans, with individuals with chronic pain reporting cigarette smoking to cope. In their review, the authors highlight potential mechanisms linking smoking and pain including smoking as a means of distraction from pain, nicotine as an analgesic, and a biopsychosocial model for pain that addresses the complex interactions among biological stimuli, psychological effects of the stimulus, and social factors such as social views. The authors report on relationships between smoking and medical conditions, quality of life, prescriptions for pain medication, mental health disorders, and other associations. Given the small number of articles reviewed, the number of articles in each category was limited. The authors noted that smoking may be a mechanism to cope with pain and mental health conditions. The authors concluded by reporting a similar or higher prevalence of smoking among veterans when compared with the general population, and while multiple mechanisms may increase their level of pain, smoking may be a coping mechanism. Future research in this area is needed.

The last article by Tsai and Rosenheck (18) in the series examines risk factors for homelessness among veterans. Homelessness is defined as not having a fixed, regular, and adequate nighttime residence. Veterans are overrepresented in the homeless population, comprising 12.3% of all homeless adults in the United States but only 9.7% of the overall US population. In this article, the authors synthesized data from 31 studies, examining risk factors for homelessness in veterans. The more rigorous studies included a large cohort, case-control design, or studies based on recognized designs, and the less rigorous studies included those that were cross-sectional, descriptive, specific-focus or other uncontrolled studies, and studies comparing homeless veterans with homeless nonveterans. Although poverty is a pervasive risk factor among all homeless persons, the strongest risk factors identified for veterans were substance use disorders and mental illness. In veterans, schizophrenia and alcohol and drug use disorders were prevalent. Post-traumatic stress disorder, while more prevalent among veterans, was not a more important risk factor, relative to other mental health conditions. Combat exposure among Vietnam veterans was not associated with an increased risk for homelessness. The authors speculated that this might be related to their greater likelihood of receiving compensation, pensions, and other health benefits. While deployed Operation Enduring Freedom/Operation Iraqi Freedom veterans were not at greater risk for homelessness than deployed veterans of other eras, they were at greater risk for homelessness than nonheater veterans of the same era. Two additional risk factors reported include incarceration and adverse childhood experiences. Incarceration can lead to disrupted personal and social relationships, which are risk factors for homelessness. In addition, particularly in the all-volunteer military which began in the late 1970s, there is a prevalence of self-reported childhood behavioral problems, placement in foster care, and childhood trauma and abuse. Although documented in the nonveteran homeless as well, the data suggest a higher prevalence of adverse childhood events among male veterans in the all-volunteer military, compared with those without military experience. Although the risk factors for homelessness in veterans are similar to those of the adult US population, there have been unique features reported in veterans. For example, studies have found that homeless veterans are more likely to be male, better educated, and previously married compared with nonveterans. Future prospective studies that compare veterans and nonveterans are needed, particularly those that use structured diagnostic assessments. Finally, studies on risk factors that might be amenable to change have not yet been done and should be performed.

CONCLUSION

This issue presents an overview of selected health concerns of those who have served in the military and a remarkable opportunity for the myriad of stakeholders involved in their health to consider—or reconsider—approaches to better characterize and ultimately explain the differences in important health factors and outcomes that are reported in this issue of Epidemiologic Reviews. Although by no means exhaustive of the health concerns of those who served, it does provide important insights into mental, physical, and behavioral health issues.

As we look forward, there are clearly obstacles to conducting the most rigorous epidemiologic research to inform the health issues of those who serve and of veterans. In the absence of exposure randomization, high-quality observational study designs are needed to correctly attribute any adverse postdeployment health status to service exposures, such as combat zones. For many of the health conditions, we do not have a clear sense of what the baseline status was before entering military service and, if service was decades in the past, reconstruction can be challenging. The experiences of those in the military vary enormously by country of service,
era of service, and, within these, the particular role that a person may serve. This diversity leads to differences in the type and the magnitude of exposures, many of which are difficult to measure adequately, especially in the context of combat. Conducting postservice studies is further challenged by capturing a representative sample of those who served and not just those seeking care. Together, these research conditions pose tremendous challenges to synthesizing the data to sufficient granularity to draw firm conclusions to influence policy. The collective reviews in this issue provide insight into concerns that are directly relevant to, and of interest to, clinicians and researchers who provide care to those who served in the military. Within the United States, they also point to opportunities for the Department of Defense and the VA to address some of the gaps in knowledge. The VHA, within the VA, has a long history of service to the health of US veterans and of engagement with an altruistic veteran population willing to participate in experimental and observational research to advance our understanding of the role of military service on health (overview provided in a series of brochures at http://www.research.va.gov/pubs/brochure_series.cfm). The VHA’s broad research infrastructure includes extensive clinic and administrative databases, which has permitted the emergence of very large repositories of data on health and disease that affords new opportunities to inform epidemiologic inquiry and to conduct state-of-the-art population research. These include telehealth and mobile applications for clinical research and a VA-based mega cohort, the Million Veteran Program, which was launched to establish a national, representative, and longitudinal cohort of veterans for future genomic and other observational research. VHA research is also extending beyond the VHA patient base to include the majority of veterans who do not seek VHA care, a population often missing from studies in the reviews published in this issue. Further yet, in the era of multinational military interventions, Department of Defense and VA counterparts internationally need to collaborate in the collection of relevant military exposures and in characterizing short- and long-term health effects related to service to better inform the health needs of their veterans.

In the 13 systematic reviews that follow, the authors have summarized the state of science of selected health topics, highlighting what has been learned and identifying limitations that prevent the expansion of our knowledge base. Their collective work is a call to the research community internationally to continue to invest resources to better characterize military service and its impact on health. It also serves as a testament to the additional health burden carried by many of the women and men who have provided service to their country.

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Author affiliations: Massachusetts Veterans Epidemiology Research and Information Center, VA Boston Healthcare System, Jamaica Plain, Massachusetts (J. Michael Gaziano); Division of Aging, Department of Medicine, Brigham and Women’s Hospital and Harvard Medical School, Boston, Massachusetts (J. Michael Gaziano); Clinical Epidemiology Research Center, Veterans Affairs Cooperative Studies Program, West Haven, Connecticut (John Concato); Department of Internal Medicine, Yale University School of Medicine, New Haven, Connecticut (John Concato); Boston University School of Public Health, Boston, Massachusetts (Sandro Galea); Seattle Epidemiologic Research and Information Center, VA Office of Research and Development, Seattle, Washington (Nicholas L. Smith); Department of Epidemiology, University of Washington, Seattle, Washington (Nicholas L. Smith); Cooperative Studies Program Epidemiology Center-Durham, Durham, North Carolina (Dawn Provenzale); and Department of Medicine, Duke University Medical Center, Durham, North Carolina (Dawn Provenzale).

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REFERENCES


