Health risk behaviors and quality of life among recent veterans
and implications for VA health care

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Abstract

Context: The US Armed Forces are experiencing a greatly increased operational tempo due to ongoing military actions around the world. The effects of service members’ service component (active or reserve) on post-deployment health risk behaviors and quality of life have not been well characterized.

Objective: To compare post-deployment health risk behaviors and health-related quality of life (QOL) among active and reserve component veterans of ongoing military actions.

Design: Cross-sectional study based on secondary analysis of data from VA’s outpatient Survey of Healthcare Experiences of Patients (SHEP).

Setting: Survey mailed monthly to a stratified random sample of veterans who received outpatient care at VA facilities in FY2005.

Participants: Outpatients with confirmed deployment in support of Operation Enduring Freedom (OEF) and/or Operation Iraqi Freedom (OIF) (n=7,156).

Measures: Demographic patient characteristics, AUDIT-C (alcohol use), smoking status, estimated BMI, SF-12 MCS (mental) and PCS (physical) QOL scales.

Results: In unadjusted analyses, active component members were more likely to report binge drinking (p=0.008), healthy BMI (p<0.001) or obese BMI (p=0.04). These differences disappeared after adjusting for covariates. In adjusted analyses, reserve component members were more likely to report a lifetime history of smoking >100 cigarettes (p=0.02). Adjusted mean BMI (p=0.03) and SF-12 MCS (p=0.007) were slightly higher for active component members.
Conclusions: Service category was not associated with post-deployment health risk behaviors after controlling for demographic covariates. Statistically significant differences in BMI and mental well-being were small and not clinically meaningful. Health risk behaviors are highly prevalent in this post-deployment population, and mental and physical well-being scores are below national means.
Introduction

Background

Since the attacks of 11 September 2001, members of the United States armed services have experienced a greatly accelerated operational tempo. The majority of soldiers, sailors, airmen and marines have deployed in support of Operation Enduring Freedom (OEF) or Operation Iraqi Freedom (OIF) at least once, with many accumulating multiple overseas tours. The burden of these deployments has been shared by active-component and reserve-component (Reserve and National Guard) servicemen and women.

Active-component service members train for combat and combat support duties as a full-time job, whereas reserve-component forces have less extensive training and more ties to communities outside the military. These baseline differences may affect the service members’ psychological resiliency and response to the stresses of deployment. Initial investigations have revealed significant and lasting psychological stress among mobilized reserve-component service members and differences between active and reserve components. Experiences during deployment are a significant source of traumatic stressors among military personnel and veterans. Active duty and reserve component units share some common post-deployment debriefing procedures, such as the Post-Deployment Health Assessment (PDHA) and Post-Deployment Health Re-Assessment (PDHRA). However, some differences remain in the post-deployment treatment of active-component and reserve-component service members. When reserve-component units return from deployment, they usually demobilize and their members reintegrate into the civilian world. Upon their return, by contrast, active-component units prepare for the next mission, which may involve another combat tour. These post-deployment differences may contribute to the lasting effects of deployment stresses on service members.
Scope of population

Both active-component and reserve-component cohorts are likely to include wounded veterans, combat stress casualties and combat veterans reintegrating to civilian life. Post-deployment assessments of returning units using anonymous surveys have found significant levels of psychiatric distress (15.6 to 17.1%) but significant underutilization of mental health services. Many returning veterans remain within the Department of Defense (DOD) medical system, where efforts are under way to assess and address their needs. A significant and increasing number of active duty veterans, however, are leaving the service and the DOD medical system. After separation from the military, these veterans are eligible for 2 years of enhanced eligibility and priority for Veterans’ Affairs (VA) health care. Likewise, reserve component veterans whose units demobilize upon returning from deployments lack access to the DOD medical system but share the same eligibility for VA health care accorded to active duty veterans. As of mid-February 2005, 244,054 OIF/OEF veterans were eligible for VA health care and 48,733 (20%) had received VA services; up to 26% of these veterans presented with symptoms of a possible mental health disorder. By April 2007, the number of eligible OEF/OIF veterans had increased to 686,306; at least 229,015 (33%) of those have received VA services, with over 36% presenting with mental health complaints.

Mental health and other health concerns in veteran populations

The most prevalent mental health disorders in the VA health care system include substance abuse (including tobacco and alcohol), post-traumatic stress disorder (PTSD) and adjustment disorders. PTSD is itself associated with health risk behaviors such as smoking and alcohol abuse. Several studies have shown an association between PTSD and increased
utilization of medical services as well as higher lifetime prevalence of circulatory, digestive, musculoskeletal, nervous system and respiratory diseases. PTSD is also associated with self-reported mental and physical health problems and poorer quality of life (QOL). Although PTSD is not the focus of this study, its prevalence and effects are important considerations in evaluating the health behaviors and quality of life in this population. Furthermore, exposure to traumatic stressors during deployments, even without a diagnosis of PTSD, is associated with increases in smoking and risky drinking and decreases in reported quality of life.

The burden of health risk behaviors cannot be overstated. Alcohol is causally related to over 60 different medical conditions and is responsible for up to 4% of the global burden of disease. Alcohol abuse is more prevalent among military personnel and veterans than in civilian counterparts, and is associated with significant loss of productivity, morbidity and mortality. Alcohol can also accentuate symptoms of PTSD and other mental health concerns in veterans. The morbidity and mortality caused by tobacco smoking are well documented. Military personnel and veterans are significantly more likely than civilian counterparts to smoke. Overweight and obesity are an important cause of morbidity, disability and mortality. Although military personnel are less likely to be overweight or obese than civilian counterparts, weight management is still a key issue for service members. Overweight service members encounter difficulty with physical readiness for combat and have higher likelihood of depression. Veterans are more likely than civilian counterparts to be overweight or obese.

Quality of life (QOL) is an important patient-centered outcome. Previous investigations have revealed significant differences in perceived quality of life between active and reserve component personnel. Veterans report significantly lower physical and mental quality of life.
than civilian counterparts. Additionally, military personnel who have deployed to a combat zone report worse QOL than those who have not deployed.

**Rationale for study**

The existing medical literature indicates a significant burden of health risk behaviors among active component, reserve component and veteran populations. The evidence also indicates that deployment may affect active component and reserve component service members differently. This study was designed to investigate differences in post-deployment health risk behaviors and quality of life between active duty and reserve component service members utilizing VA health care. A refined understanding of new veterans' mental health and disease prevention needs and quality of life will help guide VA and DOD policymakers to support the most effective treatment plans and develop more effective future programs.
Methods

Data Source and Sample

This was a cross-sectional study based on secondary analysis of data regularly collected by the VA in support of quality improvement efforts. The Survey of Healthcare Experiences of Patients (SHEP), administered by the VA Office of Quality and Performance (OQP), periodically solicits information on patient satisfaction, quality of life and health behaviors. This survey uses a stratified random sample without replacement design to ensure appropriate representation of new primary care, established primary care and specialty care patients from each VA clinic in the health care network (N=711). The survey is mailed using a modified Dillman method.40

Selection Procedures

Our sample derives from the SHEP, which is mailed monthly to a sample of veterans who were seen in VA clinics during the prior 30 days. The FY2005 SHEP surveyed patients seen between October 1, 2004 and September 30, 2005. In order to select an OEF/OIF sample, a de-identified patient-level data file including all OEF and OIF veterans initially selected to receive the SHEP was obtained from OQP through use of an approved data use agreement. OEF/OIF service was verified with the DOD’s Defense Manpower Data Center (DMDC) and VA’s Health Care Eligibility Center.

Measures

The SHEP assesses key demographic characteristics, including gender, race, Hispanic origin, marital status, education, income, and employment. Respondents’ self-reported race and ethnic origin were used to categorize individual records as white non-Hispanic, black non-
Hispanic, Hispanic of any race, and other (including Asian/Pacific Islander and Native American / Alaskan). Age was calculated as respondents' age on January 1, 2005 based on date of birth in VA records.

The SHEP assesses alcohol use with the AUDIT-C, an instrument derived from the three consumption questions of the World Health Organization's Alcohol Use Disorders Identification Test (AUDIT). This instrument has demonstrated reliability and validity when compared with interview-based assessments in both VA and general US populations. After calculating respondents' AUDIT-C scores (see Figure 1), previously-reported empirical gender-specific cutoffs were applied. Likely hazardous drinking was defined as a score ≥ 4 for men or ≥ 3 for women. Possible alcohol use disorder (AUD) was defined as a score ≥ 6 for men or ≥ 4 for women. Binge drinking was defined as consuming at least 6 drinks per occasion on at least a monthly basis.

Tobacco use was assessed with the question “Have you ever smoked cigarettes?” The SHEP survey design allowed us to assess both current and past smoking status with this one question; possible responses and scoring are listed in Figure 1. Survey assessments of self-reported smoking status and history of smoking have demonstrated reliability and validity in a variety of populations.

Overweight and obesity were assessed using BMI calculated from self-reported height and weight. Self-reported height and weight data have demonstrated reliability and validity for epidemiologic studies. SHEP data report height in inches from 5 feet 0 inches to 6 feet 3 inches and weight in 10-pound intervals from 90 to 310 pounds. Weights were assigned as the median value of the self-reported 10-pound range. After BMI calculation, individual BMI scores were classified as healthy (BMI <25), overweight (BMI 25-30) or obese (BMI >30).
Health-related quality of life was assessed using the 12-question short form health survey for veterans (SF-12V) mental component scale (MCS) and physical component scale (PCS). The SF-12V is a widely used, broadly accepted instrument which has demonstrated reliability and validity in a variety of populations. Self-reported health status and health-related QOL are valid measures of health status among military personnel, and the SF-12V instrument specifically has been used extensively in studies of veteran populations.

Analyses

The small size of some cells in this study required that data on demographic characteristics be consolidated according to conventional categories. Descriptive statistics were calculated to characterize demographic attributes by service category. As appropriate, t test, Pearson’s $\chi^2$, Fisher’s exact test or ANOVA analysis was employed to test the association between demographic attributes and unadjusted outcome variables by service category. Significant ANOVA results were followed with post-hoc analyses. Statistical significance for differences in unadjusted prevalences was set at two-sided $\alpha$ of 0.05.

Logistic regression analyses controlling for demographic attributes were used to determine adjusted odds ratios for behaviors; a separate model was used for each health risk behavior. Multiple regression analysis was used to determine service category-specific adjusted mean AUDIT-C score, BMI, and SF-12 MCS and PCS scores. Covariates were only excluded from models if they were insignificant in both bivariate and multivariate analyses. Statistical differences for adjusted mean scores were evaluated using two-sided significance tests at the 0.05 level with Bonferroni correction for multiple comparisons. All analyses were conducted on STATA version 9.0.
Results

Response Rates

Among FY05 SHEP respondents of all ages and all eras of service, the overall response rate was 58.7%, with older veterans significantly more likely to respond than younger veterans. The OEF/OIF sample response rate was 21.4% ($n = 1530$; see Figure 2), significantly lower than the overall rate but consistent with the expected age-related non-response pattern.

Demographic characteristics by service category

Table 1 displays demographic characteristics of OEF/OIF SHEP responders by service category. The relative proportions of active and reserve veterans in the sample mirror those represented in the OEF/OIF population. Initial analysis reveals significant differences between active and reserve populations in nearly every measured demographic variable. Reserve veterans were older; were more likely to self-identify as white non-Hispanic; were more likely to be currently married; were more likely to have a college degree; were more likely to be employed; and reported a higher income. Active component veterans were younger; were more likely to self-identify as Hispanic or “other” race; were more likely to have never been married; were more likely to be full-time students or unemployed; and reported lower income. The gender makeup of each service category was comparable to the other and to reported current DOD demographic makeup.

Bivariate results for health risk behaviors

Reported prevalences of measured health risk behaviors are found in Table 2. Rates of potentially hazardous alcohol use and of binge drinking were markedly higher than those
reported in a 2005 DOD survey of active duty service members.\textsuperscript{22} By contrast, this study finds that current smoking is less prevalent in recent veteran populations than the 2005 DOD survey would indicate. We also found higher rates of obesity and lower rates of overweight than the 2005 DOD survey, although the overall rate of overweight/obesity was comparable.

**Multivariate results for health risk behaviors**

Unadjusted and adjusted odds ratios for reporting participation in health risk behaviors are found in Table 2. Each significant difference between the service categories in the unadjusted analysis became insignificant after controlling for demographic differences. Veterans of reserve component units were more likely to have reported any lifetime history of smoking (>100 cigarettes total) than were active component veterans. However, we found no significant differences in reported modifiable risk behaviors between active and reserve component veterans. The adjusted mean AUDIT-C score for each service category (Table 3) was consistent with likely hazardous drinking for men and possible AUD for women. There was a small difference in mean BMI, although the mean for each service category was in the overweight range.

**Multivariate results for quality of life**

Unadjusted mean scores for physical quality of life (Table 3) were slightly higher for active than for reserve component veterans; this difference was not significant in the multivariate model. Adjusted mean scores for mental quality of life were slightly higher for active than for reserve component veterans. The adjusted mental and physical component scores were lower for
both groups than for the US general population, as the scales are designed such that the population mean score is 50.\textsuperscript{59}
Discussion

Significant findings

Our analysis demonstrates that alcohol drinking, tobacco smoking and poor weight management are highly prevalent in a population of service members receiving care at VA medical facilities but that these post-deployment health risk behaviors are not significantly associated with service component. The only behavioral difference between service components—lifetime smoking history—is not a modifiable risk behavior. A difference of less than one point in mean BMI is clinically unimportant when both groups' reported means are consistent with overweight. Behavioral differences between these two populations may be attributed to the numerous significant baseline demographic differences. In each individual behavioral model, age was the most strongly associated demographic variable. Younger veterans were more likely to have AUDIT-C scores consistent with possible AUD, to engage in binge drinking, and to currently smoke; older veterans were more likely to be obese. This analysis revealed no significant gender-related differences in health risk behaviors.

Our investigation of mental well-being revealed several important considerations. Veterans who served with both active and reserve component units report SF-12V mental component scores well below the US population mean, thus indicating poorer mental health status. This is consistent with the findings of prior studies of veterans in general. We found a two-point difference in adjusted mean scores, with reserve component veterans reporting lower quality of life than active veterans. This finding may reflect the different deployment expectations of the two populations and the difficulties experienced by reserve service members reintegrating into the civilian world after redeployment. Further research is necessary to explore the reasons for this difference.
Limitations of this study

This study examines the best available data at the time of analysis, which was collected between October 2004 and September 2005. However, newer SHEP samples will include larger OEF/OIF samples due to the rapidly increasing number of recent veterans receiving VA health care. The SHEP examines recipients of VA services only; at present, just one-third of the eligible population seeks care in VA facilities. The low response rates in our population of interest limit our ability to make and generalize inferences. We are uncertain how representative the respondents are of the larger population from which they come.

The present study employs screening tools rather than confirmed diagnoses. The inherent uncertainty of self-reported height and weight, especially with the imprecise weight categories employed, limits the reliability of our estimated mean BMI values. This study may underestimate the prevalence of overweight and obesity due to the tendency of survey participants to understate weight and overstate height. Alternatively, our design may overestimate the prevalence of overweight and obesity because estimated BMI does not account for the possibility of increased muscle mass and bone density in this population. This study may overestimate the prevalence of alcohol and tobacco behaviors because it selectively samples a care-seeking population, but may also underestimate these same behaviors because of selective non-response bias.
Policy implications

This study underscores the importance of consistent, equitable, accessible health care for all service members and veterans regardless of whether they deployed with active or reserve component units. Policymakers should seek to ensure that the same resources are available to active and reserve component service members and veterans during and after deployments. Clinicians should be aware of the inherent demographic differences between the groups and the attendant differences in behavioral patterns.

The prevalence of health risk behaviors in this rapidly expanding population calls for continued careful monitoring, ideally with a tailored survey instrument. Such an instrument should address some of the limitations of the present study by more accurately measuring weight and providing more timely results. Further, any new instrument must gather information on additional critical health risk behaviors, including smokeless tobacco use, illicit drug use, misuse of prescription drugs, risky sexual behaviors and non-adherence to preventive medicine recommendations.

At present, the individual government agencies overseeing various portions of the continuum of service employ a great number of prevention programs with varying degrees of success. DOD creates both medical and workplace-integrated alcohol and drug abuse prevention and control programs and requires each branch of service to implement and enforce its policies. Each branch of service sets its own weight management and physical fitness requirements and develops programs to enforce those standards. The Army National Guard’s “Decade of Health” program raises awareness about one prevention topic per year through an aggressive targeted marketing campaign; to date, dental health and hypertension have been targeted. VA’s MOVE! provides clinicians and patients with the resources to address overweight and obesity.
HealthierUS Veterans, a collaboration between VA and the Department of Health and Human Services (HHS) combines “inreach” to VA users and outreach to veterans in the community to combat overweight, obesity and diabetes.68

Each of these programs focuses on a single segment of the service member-veteran population and a fraction of the spectrum of health risk behaviors. This piecemeal approach is inherently incompatible with the goal of providing equitable care to all members of the population. Further, competition for shared financial and clinical resources limits the maximum possible effectiveness of these programs. Interagency collaboration is essential to the provision of adequate health care and prevention for this population.

We cannot overstate the importance of addressing health risk behaviors. The medical, psychological, social and economic sequelae of alcohol abuse, binge drinking, tobacco smoking and poor weight management have been extensively documented. Without timely and effective interventions, these behaviors may significantly affect the health of individual veterans and the utilization of limited resources in the VA health care system for decades to come. Proper prevention requires the concerted efforts of DOD, VA and community clinicians as well as continuing research and programmatic advances.
Figure 1. SHEP alcohol and tobacco questions

How often did you have a drink containing alcohol in the past 12 months? Consider a “drink” to be a can or bottle of beer, a glass of wine, a wine cooler, or one cocktail or a shot of hard liquor.

<table>
<thead>
<tr>
<th>0: Never</th>
<th>1: Monthly or less</th>
<th>2: 2-4/month</th>
<th>3: 2-3/wk</th>
<th>4: 4+/wk</th>
</tr>
</thead>
</table>

How many drinks containing alcohol did you have on a typical day when you were drinking in the past 12 months?

<table>
<thead>
<tr>
<th>0: 0-2</th>
<th>1: 3-4</th>
<th>2: 5-6</th>
<th>3: 7-9</th>
<th>4: 10+</th>
</tr>
</thead>
</table>

How often did you have 6 or more drinks on one occasion in the past 12 months?

<table>
<thead>
<tr>
<th>0: Never</th>
<th>1: Less than monthly</th>
<th>2: Monthly</th>
<th>3: Weekly</th>
<th>4: Daily</th>
</tr>
</thead>
</table>

Have you ever smoked cigarettes?

<table>
<thead>
<tr>
<th>Current smoker</th>
<th>Ever smoked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, still smoking every day</td>
<td>+</td>
</tr>
<tr>
<td>Yes, still smoking some days</td>
<td>+</td>
</tr>
<tr>
<td>Yes, but no longer smoke at all</td>
<td>+</td>
</tr>
<tr>
<td>No, never smoked</td>
<td>+</td>
</tr>
</tbody>
</table>

Figure 2. Sample selection

FY2005 Outpatient SHEP
N = 428,000

DMDC-verified OEF/OIF sample
7,156

Unable to contact
164 (2.3%)

Respondents
1530 (21.4%)

Non-respondents
5462 (76.3%)
<table>
<thead>
<tr>
<th>TABLE 1. Demographic characteristics of OEF/OIF SHEP responders by service category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Age, yr</td>
</tr>
<tr>
<td>&lt;25</td>
</tr>
<tr>
<td>26-35</td>
</tr>
<tr>
<td>36-45</td>
</tr>
<tr>
<td>&gt;45</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
</tr>
<tr>
<td>White non-hispanic</td>
</tr>
<tr>
<td>Black non-hispanic</td>
</tr>
<tr>
<td>Hispanic of any race</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Marital status</td>
</tr>
<tr>
<td>Married</td>
</tr>
<tr>
<td>Divorced or separated</td>
</tr>
<tr>
<td>Never married</td>
</tr>
<tr>
<td>Education</td>
</tr>
<tr>
<td>High School or less</td>
</tr>
<tr>
<td>Some college</td>
</tr>
<tr>
<td>College grad or higher</td>
</tr>
<tr>
<td>Employment</td>
</tr>
<tr>
<td>Wages or self-employed</td>
</tr>
<tr>
<td>Full-time student</td>
</tr>
<tr>
<td>Unemployed/other</td>
</tr>
<tr>
<td>Income ($)</td>
</tr>
<tr>
<td>&lt;30,000</td>
</tr>
<tr>
<td>&gt;30,000</td>
</tr>
</tbody>
</table>

* p<0.05
† p<0.01
‡ p<0.001
### TABLE 2. Health risk behaviors by service category

<table>
<thead>
<tr>
<th>Unadjusted</th>
<th>Adjusted*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>Reserve</td>
</tr>
<tr>
<td>Alcohol use</td>
<td></td>
</tr>
<tr>
<td>Any hazardous drinking</td>
<td>251/488 (53.6%)</td>
</tr>
<tr>
<td>Possible alcohol use disorder</td>
<td>144/488 (30.8%)</td>
</tr>
<tr>
<td>Binge drinking (≥6 drinks)</td>
<td>304/479 (63.5%)</td>
</tr>
<tr>
<td>Tobacco smoking</td>
<td></td>
</tr>
<tr>
<td>Current smoker (past 2 weeks)</td>
<td>159/508 (26.2%)</td>
</tr>
<tr>
<td>Ever smoked (100+ cigarettes)</td>
<td>305/608 (50.2%)</td>
</tr>
<tr>
<td>Body composition</td>
<td></td>
</tr>
<tr>
<td>Healthy weight (BMI ≤25)</td>
<td>189/598 (31.6%)</td>
</tr>
<tr>
<td>Overweight (BMI &gt;25 but ≤30)</td>
<td>261/598 (43.6%)</td>
</tr>
<tr>
<td>Obese (BMI &gt;30)</td>
<td>148/598 (24.7%)</td>
</tr>
</tbody>
</table>

*Adjusted for demographic factors listed in Table 1 unless otherwise noted
† Model omits race
‡ Model omits sex
§ Model omits employment
¶ p<0.05
<table>
<thead>
<tr>
<th>Adjusted mean (SE)</th>
<th>Adjusted mean (SE)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol use (AUDIT-C)</td>
<td>4.17 (0.12)</td>
</tr>
<tr>
<td>Body composition (BMI)</td>
<td>27.4 (0.20)</td>
</tr>
<tr>
<td>Mental quality of life (SF-12 MCS)</td>
<td>45.9 (0.51)</td>
</tr>
<tr>
<td>Physical quality of life (SF-12 PCS)</td>
<td>45.4 (0.50)</td>
</tr>
</tbody>
</table>

*Adjusted for demographic factors listed in Table 1 unless otherwise noted
† Model omits race
‡ Model omits sex
¶ p<0.05
§ p<0.01
Addendum I: Systematic review of the evidence

In order to properly identify and address the numerous issues in this study, it was first necessary to review the existing medical and policy literature. The review was conducted in three phases. In the first phase, recent articles concerning military personnel and veterans were examined to fine tune the research question and establish a rationale for the study. In the second phase, the literature was examined to gain an appreciation for the burden of selected conditions and behaviors in the VA, the military, and the US population in general. Past studies concerning health-related quality of life (QOL) in these populations were also examined. In the final phase, articles concerning the instruments used in the study were reviewed to determine the value of their results.

Phase I: Deployment and its effects

The target population in this study includes all veterans of ongoing US military operations. This population includes persons who are still serving on active duty in the military (active component), those who are still serving in the National Guard or Reserves (reserve component), and those who have completed their service and either retired or been separated from the military ("veterans"). The veteran subpopulation includes persons who served in active component units, in reserve components or both. Members of this population have generally deployed either to Afghanistan (OEF) or to Kuwait or Iraq (OIF), but some may have deployed to other regions in support of the same operations.

The literature was reviewed to determine which behaviors and characteristics are important in examining post-deployment mental health and disease prevention. The review employed search terms designed to capture the population and exposure under investigation.
MeSH headings “Military personnel”, “Veterans” and “United States Department of Veterans Affairs” as well as keywords “Active duty”, “Reserve” and “National Guard” were used to capture as many studies involving this population as possible. There are no appropriate MeSH headings for military deployment, so MeSH headings “War” and “Combat disorders” as well as keywords “deployment” and “post-deployment” were used. Some aspects of current military operations may be similar to the 1991 Persian Gulf War; as such, the MeSH heading “Gulf War” was also included. The initial strategy sought articles containing any of the population OR exposure characteristics, which returned an unmanageable 83,853 articles. However, population and exposure are two distinct criteria. As such, a second search was conducted for articles containing any of the population characteristics AND at least one of the exposure terms. This returned 620 articles, of which 67 were review articles.

Once the results of the initial search were compiled, selection criteria were applied to weed out studies which did not contribute to the development of the research framework. The broad scope of the initial search terms necessarily included studies which addressed historical conflicts and tangentially-related issues. Studies were excluded from further review if they dealt with military engagements prior to the 1991 Persian Gulf War. There were sufficient studies in American populations to exclude all articles focused on the armed forces and peacekeeping forces of other nations. Articles focused on a single disease or condition unrelated to health risk behaviors or mental health were excluded unless they also addressed quality of life. In all, 115 abstracts were reviewed, including those of 12 review articles. Dates of publication ranged from 1994 through 2007. After reviewing abstracts, all 12 review articles and an additional 22 articles were read in their entirety. These were used to elicit common themes in post-deployment mental health and health risk behaviors.
Phase II: Burden of disease

Health risk behaviors contribute to the global burden of disease both directly and indirectly. The major health risk behaviors identified in the literature were tobacco use, alcohol use, illicit drug use, overweight/obesity, and non-adherence to preventive medicine regimens. In order to capture all articles addressing these behaviors, a new search strategy was devised. The MeSH headings “Alcohol drinking”, “Alcohol related disorder”, “Tobacco”, “Smoking”, “Tobacco Use Disorder”, “Overweight”, “Obesity” and “Obesity, Morbid” as well as keywords “risk”, “health risk” and “behavior” were combined with the population terms previously described. Searches were run both with and without the exposure terms previously described. This strategy returned 9600 articles, of which 1310 were review articles. Removal of the non-MeSH keyword terms from the search reduced the return to 1723 articles, of which 121 were review articles. The review articles were screened for applicability to the target population using the criteria previously described; 37 review articles were selected for further review. Key references from these articles were also reviewed and included. The 2005 Survey of Health Related Behaviors Among Active Duty Personnel, commissioned by DOD and published in late 2006, was obtained as an additional resource in describing the prevalence and impact of health risk behaviors in this population.

Alcohol use was identified as a common risk behavior before and after but not during deployment. Approximately 20% of active duty service members endorse heavy alcohol use, a proportion which has been relatively constant for the past 25 years and which significantly exceeds the proportion of civilian counterparts who endorse the same activity. Alcohol use is causally related to over 60 health conditions and accounts for up to 4% of the global burden of disease. In addition to direct health effects, alcohol use is the cause of
productivity loss, loss of employment, legal consequences and vehicle accidents in this population.\textsuperscript{21,22,70}

Tobacco use, including both cigarette smoking and smokeless tobacco, was identified as a common risk behavior before, during and after deployment.\textsuperscript{4,20,23-25,32,37,39} Approximately 32\% of active duty service members currently smoke, with approximately 38\% of those having initiated their tobacco habit during their period of service.\textsuperscript{22} Tobacco is causally associated with a wide variety of cardiovascular, respiratory and neoplastic conditions and accounts for at least 4\% of the global burden of disease.\textsuperscript{19}

Weight management, a combination of dietary and lifestyle behaviors, was identified as an important characteristic affecting ability to deploy, performance during deployment, and mental and physical health after deployment.\textsuperscript{20,29-35,73,74} Overweight or obesity was identified as an independent predictor of other health risk behaviors, including tobacco and alcohol use.\textsuperscript{73} Overweight and obesity are associated with poor post-deployment mental health among active-duty personnel and poor quality of life in veterans.\textsuperscript{31,35,74} In addition to health effects, failure to meet body composition standards is a significant reason for lost promotion opportunities and separation from the service.\textsuperscript{29,30,32,33}

Non-adherence to immunization and prophylactic regimens prescribed for anticipated infectious disease exposures was also identified as a health risk behavior, although this is not assessed by the SHEP.\textsuperscript{75-77} Additionally, illicit drug use has historically been a problem in this population but has been declining in importance and is not assessed by SHEP.\textsuperscript{22,78}
Phase II: Quality of Life

A significant theme identified in the initial literature search was the importance of traumatic stress in post-deployment mental health, behaviors, and quality of life. PTSD is the most well-known combat stress disorder, and is associated with increased prevalence of health risk behaviors and decreased quality of life. However, numerous studies demonstrated that the effects of combat stress far exceed the direct burden of PTSD. Deployment itself can be a stressor with serious effects on behavioral and mental health and QOL. Exposures during deployments which fail to induce clinically diagnosable PTSD may nonetheless influence post-deployment behaviors and QOL.

In order to assess the current literature on QOL in this population, a third search was conducted. The population terms previously employed were combined with MeSH heading “Quality of Life” and keyword “quality of life”, yielding 587 articles of which 118 were review articles. Application of the previously-described selection criteria reduced the return to 15 articles, of which 3 were review articles. A later search on specific QOL instruments (described below) returned additional articles not captured by this initial search, which were subsequently reviewed for general QOL information.

Important findings concerned the effects of service component and deployment on QOL. One investigation reported significant differences in perceived quality of life between active and reserve component personnel. Military personnel who have deployed to a combat zone report worse QOL than those who have not deployed. Finally, the effects of military service in general on QOL are borne out by evidence that veterans report significantly lower physical and mental quality of life than their civilian counterparts.
Phase III: Instruments

The final step of the literature review was to gather evidence regarding each of the instruments to be used in this study. The goal was to elicit as much information as possible about the instruments’ reliability and validity in the target population and in the general American population. Where available, subpopulations based on demographic factors or medical conditions were examined to gain a thorough understanding of the range of populations the instruments are capable of assessing.

Alcohol use is assessed in this study using the AUDIT-C. This is a three-item instrument derived from the first three questions of the World Health Organization’s Alcohol Use Disorders Identification Test (AUDIT). These questions assess the frequency and quantity of alcohol consumption as well as binge drinking behaviors. Each question is scored from 0-4 and the responses summed for a total range of 0-12. The AUDIT-C is designed for use either as a clinician-administered screening tool or as a self-reported survey tool. Use of the AUDIT-C in this study required verification that self-reported alcohol drinking behaviors are reliable and valid, as well as verification that the AUDIT-C is a valid and reliable instrument in the target population.

A literature search for the previously described alcohol terms and keyword “self-report” was conducted both with and without the previously described population terms. This yielded 823 articles, of which 36 were review articles. The review articles were screened for applicability to the present study and reviewed. Various alcohol self-reporting instruments have been reported to have test-retest reliability ranging from 0.65-0.85 in general populations and the target population. Non-response bias is the most problematic issue in assessing the validity of this instrument; users of alcohol, tobacco, and illicit drugs are the most frequent non-
responders on health surveys.\textsuperscript{47,63,80,81} As a result, the SHEP could significantly underestimate the prevalence of risky drinking behaviors in the target population; however, there is no reason to think this underestimation is differentially distributed between the service categories.

A literature search for the previously described population terms and keyword “AUDIT-C” returned 6 articles, none of which were review articles. Further investigation of the instrument through selected references returned an additional 5 articles. The AUDIT-C instrument has demonstrated reliability and validity when compared with interview-based assessments in both VA and general US populations.\textsuperscript{42-45} The best estimate of the sensitivity of the instrument in the target population is 0.81 with generic and 0.84 with gender-specific cutoff criteria; specificity is 0.85 with generic and 0.86 with specific cutoff criteria.\textsuperscript{72} Use of gender-specific cutoff criteria is supported by the literature and allows discrimination of various levels of risk.

Tobacco use was assessed with the question “Have you ever smoked cigarettes?” The possible responses allowed categorization of current and former smokers. In order to determine the reliability and validity of self-reported smoking status, the previously described smoking terms were combined with keywords “validity” and “self-report.” This yielded 73 articles, of which 11 were review articles. The articles were reviewed for applicability to the present study. The highest-quality individual study, which compared self-reported smoking status to serum cotinine levels, reported a sensitivity of 0.94 and specificity of 0.97.\textsuperscript{82} A systematic review and meta-analysis placed the best estimates of sensitivity at 0.875 and specificity of 0.892, with the best results in adult populations.\textsuperscript{49}

Overweight and obesity were assessed using BMI calculated from self-reported height and weight. This study required verification both of the BMI instrument and of the self-reported
height and weight values used in its calculation.\textsuperscript{50} SHEP data report height in inches from 5 feet 0 inches to 6 feet 3 inches and weight in 10-pound intervals from 90 to 310 pounds. Weights were assigned as the median value of the self-reported 10-pound range. The precision of the calculated BMI was therefore inherently reduced by the format of the SHEP questionnaire. A review of the literature for MeSH headings “Body Mass Index” and “Reproducibility of Results” with keyword “self-reported” returned 20 articles. Three of these were selected as applicable to the present study and an additional article was selected from among the references.

Survey respondents tend to underestimate their weight and overestimate their height, but the effect on calculated BMI may not be significant. The best-conducted study demonstrated sensitivity of 74\% and specificity of 99\% when BMI calculated based on self-reported height and weight is compared to BMI calculated based on measured height and weight.\textsuperscript{60} However, a smaller, more recent study reported a 0.92 to 0.94 correlation between self-reported and measured BMI.\textsuperscript{83} Both reporting biases tend to decrease the calculated BMI; the average bias may be about 1.14 points.\textsuperscript{62} The consensus is that while self-reported BMI may not accurately guide clinical decisions, it is reliable for epidemiologic studies of overweight and obesity.\textsuperscript{50} For the purposes of this study, individuals were classified as healthy, overweight or obese based on expert guidelines.\textsuperscript{51}

This study employs the 12-item short form health survey (SF-12) mental component scale (MCS) and physical component scale (PCS) to evaluate health-related quality of life. This instrument consists of 12 questions chosen from the 36-item short form health survey (SF-36), and achieves 0.90 correlation on both PCS and MCS scores with one-third the questions.\textsuperscript{52} A review of the literature using the previously described population terms and keyword “SF-12” yielded 8 articles, none of which were review articles. Of those, two were identified as
applicable to the present study. In order to gain a more thorough understanding of the SF-12’s applicability, an additional search was conducted using MeSH heading “Reproducibility of Results” and keyword “SF-12.” This returned 84 articles, of which 5 were review articles; of these, 10 articles were selected for further review.

This literature search revealed that the SF-12 is widely used and broadly accepted as valid and reliable in a variety of populations and disease states.\textsuperscript{53, 54, 84-89} Furthermore, self-reported health status and health-related QOL are valid measures of health status among military personnel and the SF-12 instrument specifically has been used extensively in studies of veteran populations.\textsuperscript{55-57} Finally, aggregate SF-12 scores can be used to predict health care utilization and expenditures, which directly affects this study’s policy implications.\textsuperscript{90}
Addendum II: Policy implications for VA and DOD

This study examined a population and a topic that occupy the intersection of clinical and bureaucratic medicine. Health risk behaviors are at their core personal choices, and interventions rely heavily on focused individual counseling. However, the population health effects of these behaviors are staggering and individual interventions are impossible without proper system-wide programmatic support. Although this study did not investigate current programs as its primary goal, numerous successes and opportunities for improvement were noted during formative research. It is therefore appropriate to establish the ideal goals of a policy proposal; to identify current programs that may serve as foundations or springboards for policy improvement; and to recommend areas for further research and development.

Policy goals

A successful policy to address behavioral health issues must begin with a realization that service members and veterans constitute a single continuous population whose members are identified by their service to the nation. The continuum of service begins with enlistment or commissioning and continues throughout training, deployments, separation from the service and into membership in the civilian community. Many of the key inadequacies in the care afforded to service members and veterans arise from the use of discrete, bureaucratically distinct health care systems to address the needs of this population.

The ideal solution to this problem is to merge the DOD and VA health systems into a single continuous system offering identical care to all service members and veterans regardless of branch, component, or rank. However, these health systems as currently conceived are deeply embedded in the infrastructures of their corresponding cabinet-level departments. Many DOD
health care providers rotate among assignments in fixed medical treatment facilities, operational assignments with deployable units and command positions in the hierarchy of military medicine. VA health system assets share some facilities, personnel and logistical resources with other non-health aspects of the veterans’ benefits system. Extricating health system components, personnel and facilities from these two systems to form a single health system would be costly, time-consuming and detrimental to the other missions of the parent organizations.

If the DOD and VA health systems must remain somewhat discrete, policymakers should focus their efforts on improving compatibility, comparability and continuity between the systems. Possible avenues for this type of change include collective bargaining, technological standardization and information sharing. Efforts to improve these aspects of the health systems will result in better care for the target population.

One of the most salient aspects of the current United States health care system is its emphasis on free-market economics. Individuals, public and private health care providers and organizations all rely on competing third parties for some aspects of the health care process. Pharmaceutical prices, availability of imaging modalities, and the development of new tests and devices all depend on economic principles of supply and demand. Together, the DOD and VA health care systems serve over 8 million beneficiaries with an additional 60 million eligible. These systems could take advantage of their large size and collective buying power by developing a joint drug, device and diagnostic formulary. This step could potentially reduce costs and simultaneously increase intersystem compatibility and continuity of care for individual patients.

Another potential area for improvement is the employment of medical technology. Although the DOD and VA systems have historically been leaders in developing and adopting
new technologies, they do not always make compatible decisions. Some technology issues
would be resolved by the joint formulary proposed above. Electronic medical record (EMR) and
computerized physician order entry (CPOE) systems constitute another important technological
disconnect with a relatively simple and reliable solution. The development of a single
EMR/CPOE platform for all DOD and VA facilities, providers and contractors would improve
continuity of care by ensuring that no historical or treatment information is “lost in translation”
when patients transition between health systems.

Information sharing goes beyond medical records systems. DOD and VA practitioners
are, as previously noted, essentially serving a single population. As such, research concerning
young active duty service members is as applicable to VA policymakers and clinicians as to their
DOD counterparts. Ideal intellectual collaboration between DOD and VA would include joint
research initiatives, numerous conferences, common practice guidelines and joint policymaking
committees.

Fortunately, a framework for such collaboration already exists. Conferences such as
Force Health Protection and the VA/DOD Diabetes Educator Conference bring together
clinicians, researchers and experts from both health systems to share best practices and evolving
treatment options.93,94 Additionally, since 1996, DOD and VA have published joint clinical
practice guidelines which recognize the common population and clinical concerns shared by the
two systems.95 These guidelines are invaluable to clinicians making individual decisions for
individual patients. However, the guidelines can only affect the health of eligible, care-seeking
patients. The DOD/VA collaboration needs to move beyond providing support for clinical
decisions and embrace the population health model.
Program support

Efforts to address behavioral health in this population need not start from scratch. The dedicated and innovative clinicians and researchers of the DOD and VA health care systems have already developed several programs designed to reduce or ameliorate the health risk behaviors of service members and veterans. Immediate policy efforts should focus on identifying and supporting those programs with the greatest promise; standardizing and disseminating such programs throughout both DOD and VA systems; and expanding those programs to encompass more evidence-based treatment modalities and to address more health risk behaviors.

Alcohol and tobacco abuse are addressed by numerous programs and policies in these systems. DOD creates both medical and workplace-integrated alcohol and drug abuse prevention and control programs and requires each branch of service to implement and enforce its policies. VA screens all new patients for possible alcohol use disorders using the AUDIT-C; positive screens should trigger alcohol counseling, although this is not always the case. Intersystem compatibility could be increased by employing the same screening tools in both systems and reporting results in the shared medical record. Policymakers should request research on the effectiveness of the various counseling and treatment modalities employed by the VA system and the various armed services; the results of this research could be used to develop a joint treatment guideline and to support funding for program development and implementation.

Overweight, obesity and their multiple medical comorbidities are another essential area for programmatic improvement. Each branch of service sets its own weight management and physical fitness requirements and develops programs to enforce those standards. However, it is unrealistic to expect that simply being required to maintain physical fitness during active service
will ensure a lifetime of healthy habits after separation. This is a particularly complex issue, because many of the more serious sequelae of poor weight management are correlated with age and thus differentially prevalent in DOD and VA subpopulations. Ideally, a joint program would instill service members with an understanding of the importance of weight management and fitness and reinforce that understanding throughout service, separation, and civilian life.

No current program takes such a long-range approach to this lifelong problem. VA’s MOVE! provides clinicians and patients with the resources to address overweight and obesity. Unfortunately, this program is targeted to recipients of VA services and focused on mitigation of existing overweight and obesity rather than primary prevention; it therefore excludes a large portion of the population at risk. HealthierUS Veterans, a collaboration between VA and the Department of Health and Human Services (HHS) combines “inreach” to VA users and outreach to veterans in the community to combat overweight, obesity and diabetes. This program approaches the ideal goal by including veterans with and without current weight problems, and seeks to create buy-in by making veterans role models of physical fitness in the community at large. With the additional inclusion of current service members and the necessary support for implementation in the DOD system, a program like HealthierUS Veterans has the potential to greatly improve the health behaviors of this population.
Continuing research

Health risk behaviors must be understood before they can be addressed. To that end, policymakers must support targeted research on known and possible health risk behaviors in this population. DOD and VA researchers and clinicians should collaborate to design studies capable of canvassing the entire population, including recipients of DOD and VA services and those eligible for care. Ideally, researchers should design longitudinal studies capable of developing clinically useful predictive models and detecting important trends.

The present study considers the health risk behaviors and quality of life of a small sample of veterans in late 2004 and 2005. As military operations continue in Iraq and Afghanistan, further examination of these variables will be necessary. Until the ideal research model is realized, researchers should continue to perform cross-sectional studies in order to maintain an understanding of the population.

Several changes should be implemented if this study is to be repeated. A focused survey instrument should be designed to specifically address health risk behaviors. Such an instrument should reduce uncertainty by reporting weight and body composition more accurately. Additionally, the survey should return information about additional behaviors such as smokeless tobacco use, illicit drug use, risky sexual behaviors, and adherence to preventive medicine recommendations. Researchers should seek to build a larger sample size by engaging more of the at-risk population and by using follow-up mailings to increase response rates. These simple improvements could greatly improve the quality and quantity of information provided by the next iteration of this study.
Policy conclusions

No policy is useful or effective without strong political support. As such, any policy intended to address health risk behaviors in the service member and veteran population must take into consideration political, bureaucratic and financial factors as well as clinical and epidemiologic concerns. Fortunately, the current political climate is ideal for policy changes aimed at improving care for this population.

Recent news reports have brought intense public scrutiny to lapses in care and inefficiencies in the DOD and VA benefits systems. The public outcry at inadequate services for veterans sparked legislative action. Despite consistent reports of high patient satisfaction scores, there is a perceived need for immediate improvement in the VA health care system. Numerous lawmakers from both political parties have pledged to make supporting the troops and caring for our veterans their top priority. The 110th Congress’ HR 67, passed in May 2007, seeks to improve funding and support for VA medical outreach activities and collaboration with other governmental agencies.

The time is right for bold policy innovations. Policymakers must unite the DOD and VA health care systems as much as practicable, eliminating gaps in coverage and cracks into which service members may fall. Increased comparability, compatibility and continuity between these two systems will improve the quality of care afforded to this important population.
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