PREVENTING CHRONIC DISEASE

PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

PCD Collection: Veterans' Health

United States military personnel are committed to serving and protecting the public. Although those who serve are known as heroes and often seem invincible, many of our country's veterans and active-duty military personnel are at risk for or currently have chronic diseases. Data is limited on the prevalence of chronic diseases and effective interventions to prevent chronic diseases and improve health in this population. This collection of papers published in *Preventing Chronic Disease (PCD)* between November 2011 and June 2012 focuses on issues regarding the health and quality of life of veterans and military personnel. The goal in publishing these articles is to add to the body of evidence and make information on effective interventions readily available. This set of articles is hoped to serve as a catalyst to encourage researchers and practitioners working with this population to continue conducting research, implementing evidence-based interventions, and sharing their knowledge and lessons learned with others. *PCD* continues to be interested in articles on chronic disease prevention and health promotion in this population as part of its mission to promote the open exchange of information and knowledge among researchers, practitioners, policy makers, and others who strive to improve the health of the public through chronic disease prevention.

Samuel F. Posner, PhD
Editor in Chief
Preventing Chronic Disease

About this Collection

Each manuscript in this collection explores the health and wellbeing of US veterans as it relates to chronic disease. Whether it's measuring the prevalence and risk of homelessness among those who've served in our military, or examining the health-related quality of life among veterans and civilians, this collection gives readers an in-depth look at the health risks and concerns affecting our nation's service men and women.

The authors in this collection have incorporated data from The Behavioral Risk Factor Surveillance System (BRFSS), a state-based system of health surveys that collects information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury. For many states, the BRFSS is the only available source of timely, accurate data on health related behaviors.

Established in 1984 by the Centers for Disease Control and Prevention (CDC), the BRFSS is collected monthly in all 50 states and includes the District of Columbia, Puerto Rick, the US Virgin Islands, and Guam. More than 350,000 adults are interviewed each year, making BRFSS the largest telephone health survey in the world.

Preventing Chronic Disease

Preventing Chronic Disease (PCD) is a peer-reviewed electronic journal established by the National Center for Chronic Disease Prevention and Health Promotion. The mission of *PCD* is to promote the open exchange of information and knowledge among researchers, practitioners, policy makers, and others who strive to improve the health of the public through chronic disease prevention. The vision of *PCD* is to be the premier forum where practitioners and policy makers inform research and researchers help practitioners and policy makers more effectively improve the health of the population.

Articles focus on preventing and controlling chronic diseases and conditions, promoting health, and examining the biological, behavioral, physical, and social determinants of health and their impact on quality of life, morbidity, and mortality across the life span. For more information, visit www.cdc.gov/pcd.

PREVENTING CHRONIC DISEASE
PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

(SECTION I) 2012 VETERANS PAPERS

Racial/Ethnic Disparities in the Prevalence of Selected Chronic Diseases Among US Air Force Members, 2008

Jennifer J. Hatzfeld, PhD, RN, APHN-BC; Thomas A. LaVeist, PhD; Fannie G. Gaston-Johansson, PhD, RN, FAAN

Health-Related Quality of Life Among US Veterans and Civilians by Race and Ethnicity

Cecily Luncheon, MD, DrPH; Matthew Zack, MD, MPH

Evaluation of a Weight Management Program for Veterans

Alyson J. Littman, PhD, MPH; Edward J. Boyko, MD, MPH; Mary B. McDonell, MS; Stephan D. Fihn, MD, MPH

Predictors of Risk and Resilience for Posttraumatic Stress Disorder Among Ground Combat Marines: Methods of the Marine Resiliency Study

Dewleen G. Baker, MD; William P. Nash, MD; Brett T. Litz, PhD; Mark A. Geyer, PhD; Victoria B. Risbrough, PhD; Caroline M. Nievergelt, PhD; Daniel T. O'Conner, MD; Gerald E. Larson, PhD; Nicholas J. Schork, PhD; Jennifer J. Vasterling, PhD; Paul S. Hammer, MD; Jennifer A. Webb-Murphy, PhD; the MRS Team

Participant Evaluation of a Telephone-Based Osteoarthritis Self-Management Program, 2006-2009

Nina R. Sperber, PhD; Hayden B. Bosworth, PhD; Cynthia J. Coffman, PhD; Karen A. Juntilla, MEd; Jennifer H. Lindquist, MStat; Eugene Z. Oddone, MD, MHSc; Tessa A. Walker, MPH; Morris Weinberger, PhD; Kelli D. Allen, PhD

Tobacco Use Among Iraq-and Afghanistan-Era Veterans: A Qualitative Study of Barriers, Facilitators, and Treatment Preferences

Jennifer M. Gierisch, PhD, MPH; Kristy Straits-Tröster, PhD; Patrick S. Calhoun, PhD; Shawn Acheson, PhD; Kim Hamlett-Berry, PhD; Jean C. Beckham, PhD

PREVENTING CHRONIC DISEASE
PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

PREVENTING CHRONIC DISEASE
PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

(SECTION II) 2011 VETERANS PAPERS

Preventing Chronic Illness in Young Veterans by Promoting Healthful Behaviors

Rachel Widome, PhD, MHS; Alyson J. Littman, PhD, MPH, Melissa N. Laska, PhD, RD; Steven S. Fu, Md MSCE

Implementing the MOVE! Weight-Management Program in the Veterans Health Administration, 2007-2010: A Qualitative Study

Bryan J. Weiner, PhD; Lindsey Haynes-Maslow, MHA; Leila C. Kahwati, MD, MPH; Linda S. Kinsinger, MD, MPH; Marci K. Campbell, PhD

Nicotine Dependence and Its Risk Factors Among Users of Veterans Health Services, 2008-2009

Jack Tsai, PhD; Ellen L. Edens, MD, MPE; Robert A. Rosenheck, MD

Disease and Illness: Prevention, Treatment, Caring and Health

Robert J. Ursano, MD

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ORIGINAL RESEARCH

Racial/Ethnic Disparities in the Prevalence of Selected Chronic Diseases Among US Air Force Members, 2008

Jennifer J. Hatzfeld, PhD, RN, APHN-BC; Thomas A. LaVeist, PhD; Fannie G. Gaston-Johansson, PhD, RN, FAAN

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PEER REVIEWED

Abstract

Introduction
Few studies have evaluated possible racial/ethnic disparities in chronic disease prevalence among US Air Force active-duty members. Because members have equal access to free health care and preventive screening, the presence of health disparities in this population could offer new insight into the source of these disparities. Our objective was to identify whether the prevalence of 4 common chronic diseases differed by race/ethnicity in this population.

Methods
We compiled de-identified clinical and administrative data for Air Force members aged 21 or older who had been on active duty for at least 12 months as of October 2008 (N = 284,850). Multivariate logistic regression models were used to determine the prevalence of hypertension, dyslipidemia, type 2 diabetes, and asthma by race/ethnicity, controlling for rank and sex.

Results
Hypertension was the most prevalent chronic condition (5.3%), followed by dyslipidemia (4.6%), asthma (0.9%), and diabetes (0.3%). Significant differences were noted by race/ethnicity for all conditions. Compared with non-Hispanic whites, the prevalence of all chronic diseases was higher for non-Hispanic blacks; disparities for adults of other minority race/ethnicity categories were evident but less consistent.

Conclusion
The existence of racial/ethnic disparities among active-duty Air Force members, despite equal access to free health care, indicates that premilitary health risks continue after enlistment. Racial and ethnic disparities in the prevalence of these chronic diseases suggest the need to ensure preventive health care practices and community outreach efforts are effective for racial/ethnic minorities, particularly non-Hispanic blacks.

Introduction

Non-Hispanic black active-duty members of the military are 87% more likely to be hospitalized for asthma (1) and twice as likely to develop type 2 diabetes (2) as their non-Hispanic white counterparts. Similarly, compared with non-Hispanic whites, Hispanics are 29% more likely to be hospitalized for asthma (1) and 60% more likely to develop diabetes (2). Outside of the military, racial/ethnic disparities have been consistently identified in the US health care system (3), particularly in the prevalence of hypertension (4,5), dyslipidemia (4,6), diabetes (7,8), and asthma (9,10).

Throughout the US Air Force (USAF) health care system, standards for health care access are the same, regardless of geographic area, which helps to ensure each active-duty member receives the same level of health care. Additionally, every USAF active-duty member has at least a high school diploma and has been screened for pre-existing health conditions; once on active duty, each member is provided an equal housing benefit (based on rank) and has the same community resources, regardless of race/ethnicity. Collectively, the active-duty population in the USAF provides a

unique opportunity to examine the presence of health disparities in a homogenous population of different racial/ethnic backgrounds.

Despite some evidence of disparities in asthma control and diabetes incidence, each military member receives the same comprehensive health care benefits with a regular household income, adequate housing, and an additional food allowance as part of his or her military benefits. Because of these factors, we hypothesized that no clinically significant disparities would be noted.

Although consistent racial/ethnic disparities in chronic diseases have been identified outside of the military, and 2 studies have found disparities for military members in asthma hospitalization and the incidence of type 2 diabetes, the prevalence of asthma and diabetes, by race/ethnicity, has not been established. Similarly, disparities in prevalence of cardiovascular diseases, including hypertension and dyslipidemia, have not been determined in the military population. The purpose of this study was to determine whether disparities exist in the prevalence of hypertension, dylipidemia, diabetes, and asthma among active-duty USAF members.

Methods

We conducted a secondary analysis of existing clinical and administrative data for this descriptive, correlational study. The institutional review board (IRB) at Johns Hopkins University, the USAF Surgeon General's Research Oversight and Compliance Division, the IRB at the Uniformed Services University of the Health Sciences, and the USAF Clinical Informatics Branch approved the study. The USAF Clinical Informatics Branch compiled data in October 2008 for the preceding 24 months.

Chronic disease screening

Active-duty members are carefully screened before enlistment to ensure they are healthy enough for a military deployment (11). Annually, each active-duty member completes a preventive health assessment, which evaluates any new diagnoses received during the previous year and screens for chronic diseases, as recommended by the US Preventive Services Task Force. Any new medical diagnoses are also noted at that time and reviewed by the provider to determine the need for a Medical Evaluation Board, a process designed to determine whether soldiers' long-term medical conditions enable them to continue to meet medical retention standards. The Medical Evaluation Board also provides the opportunity for military physicians to clearly document soldiers' medical conditions and any duty limitations these may cause. All clinical information is maintained in a Department of Defense electronic medical record system and tracked in the Air Force medical readiness database (11).

Study variables

We compiled de-identified clinical and administrative data from all USAF members aged 21 or older and on active duty at least 12 months as of October 2008 (N = 284,850). Higher ranks (1-, 2-, 3-, and 4-star generals) were not included in the original sample because of their small numbers (n = 204) and the personalized health care support they receive. Members on active duty less than 12 months were also excluded because newly enlisted or commissioned members have up to 12 months to get an annual preventive health assessment (11). Members with a rank of "other" (n = 1,120) and/or a race/ethnicity category of "other/declined" (n = 6,762) were subsequently excluded from further analysis, for a final sample size of 277,001.

Sex, race/ethnicity, and rank category were identified through the Defense Enrollment Eligibility Reporting System. Five categories were used to identify race/ethnicity: American Indian/Alaska Native, Asian/Pacific Islander, non-Hispanic black, non-Hispanic white, and Hispanic. Rank was also categorized to ensure that people in the data set could not be identified by their demographic information. The 4 rank categories were junior enlisted (from airman basic [E-1] through senior airman [E-4]), senior enlisted (from staff sergeant [E-5] through chief master sergeant [E-9]), junior officer (from second lieutenant [O-1] through captain [O-3]), and senior officer (from major [O-4] through colonel [O-6]). A category of Other included remaining enlisted personnel (eg, special agents).

Hypertension was identified for members with 2 or more medical appointments with a credentialed provider in the previous 24 months resulting in a primary diagnosis assigned an *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) code beginning with 401 (12). The clinical definition for the diagnosis was based on the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure as a blood pressure reading above 140/90 mm Hg (13). Likewise, dyslipidemia was identified for members with 2 or more medical appointments during the previous 24 months with a primary diagnosis of dyslipidemia (ICD-9-CM code 272.4) (12), using the clinical definition from the National Heart, Lung, and Blood Institute Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults guidelines (14). Members were identified as having diabetes or asthma using the National Committee for Quality Assurance's Health Plan Employer Data and Information Set criteria (15). According to these criteria, diabetes is defined by 2 outpatient encounters with a diagnosis of diabetes (ICD-9-CM code beginning with 250), 1 emergency department or inpatient admission with diabetes, or receiving insulin or oral hypoglycemic/antihyperglycemic medications — excluding patients with a

diagnosis of gestational diabetes, polycystic ovaries, steroid-induced diabetes, or prediabetes (15). Similarly, asthma was identified for members who had a least 4 medication-dispensing events, 4 outpatient visits for asthma (ICD-9-CM code beginning with 493) with at least 2 medication-dispensing events, or 1 emergency department or inpatient admission with a principal diagnosis of asthma (15).

Appointment data, including medical diagnosis, are entered into the Standard Ambulatory Data Record according to individual facility processes and are audited monthly to ensure accuracy. This audit is centrally directed, and health care leaders at all levels in the USAF Medical Service oversee the coding accuracy results. Together with the careful monitoring of health care quality metrics, these efforts have maintained a high quality of clinical and administrative data (16).

Statistical analysis

We summarized demographic characteristics and prevalence of the 4 chronic diseases using descriptive statistics. We then created multivariate logistic regression models to calculate the prevalence of each chronic disease, adjusting for rank and sex.

Age had a strong nonlinear relationship with the prevalence of chronic diseases; therefore, we created spline terms at each 5-year interval, through age 40. This age effect differed by race/ethnicity, sex, and rank, so interaction terms for age and each of these independent variables were tested for significance. After a final model was determined for each outcome, the predicted prevalence for each race/ethnicity, by age range, was calculated with 95% confidence intervals.

Results

More than half of the study population was aged 30 or younger, and the overall prevalence of the chronic diseases studied was low; hypertension was the most prevalent (5.3%), followed by dyslipidemia (4.6%), asthma (0.9%), and diabetes (0.3%) (Table 1). After adjustment for sex and rank, the prevalence of all 4 conditions differed significantly by race/ethnicity and was positively associated with age; racial/ethnic differences in prevalence also increased with increasing age (Table 2).

Compared with non-Hispanic whites, Asian/Pacific Islander and Hispanic members aged 30 or younger had a lower prevalence of hypertension. Both American Indian/Alaska Native and non-Hispanic black members had a higher prevalence of hypertension in every age category compared with non-Hispanic whites. After the age of 25, hypertension prevalence for non-Hispanic blacks was more than double that of non-Hispanic whites in every age range.

Non-Hispanic whites had a significantly lower prevalence of dyslipidemia in every age range compared with every minority racial/ethnic group.

Similar to the differences noted with hypertension, both Hispanics and non-Hispanic blacks had a significantly higher prevalence of diabetes in all age groups compared with non-Hispanic whites. After age 30, the prevalence of diabetes for non-Hispanic blacks was more than twice that of non-Hispanic whites in every age range.

The overall prevalence of asthma was significantly lower for non-Hispanic whites in every age range than for all racial/ethnic groups.

Discussion

Compared with non-Hispanic white active-duty members in the USAF, non-Hispanic blacks are consistently and significantly more likely to be diagnosed with hypertension, dyslipidemia, diabetes, or asthma. Disparities were also noted for other racial/ethnic minorities, although these were less consistent.

The overall prevalence of hypertension in this population (5.3%) is consistent with a published prevalence of 6.7% for hypertension among 20- to 39-year-olds from the National Health and Nutrition Examination Survey (NHANES) IV (5). The NHANES IV workforce study, which was limited to employed participants in NHANES IV, found that Mexican Americans demonstrated the lowest prevalence of hypertension at 6.2%, and non-Hispanic blacks had the highest prevalence at 12.4% (6). These results are consistent with our findings that Hispanics had the lowest overall prevalence of hypertension and non-Hispanic blacks the highest. However, the fact that the prevalence of hypertension for non-Hispanic blacks was more than double that of non-Hispanic whites was a more pronounced difference and was similar to the prevalence observed among older adults (aged 65-84) in NHANES III (17).

The overall prevalence of dyslipidemia in this sample was 4.6%, which was much lower than the overall prevalence of 16.4% among employed NHANES IV participants aged 20 to 39 (6). This difference could be due to different operationalized definitions of dyslipidemia; the NHANES IV workforce study determined dyslipidemia on the basis of elevated low-density lipoprotein cholesterol results or a self-report of taking medication to lower cholesterol, rather

than coded data from medical appointments. Another potential reason for the difference could be related to the entrance standards for the USAF, which exclude many risk factors that can influence the development of dyslipidemia.

The prevalence of dyslipidemia for non-Hispanic whites in our study was 4.46%, the lowest of all racial/ethnic groups. This differed from the results of the NHANES IV workforce study, which found the highest rates for non-Hispanic whites, at 18.0% (6). However, in a systematic review of cardiovascular risk factors, no minority racial/ethnic group has consistently demonstrated a higher prevalence of high cholesterol than whites (7). The NHANES IV workforce study found a 2.4% prevalence of diabetes (6). The prevalence of diabetes for active-duty USAF members was much lower, at 0.3%. This difference could be due to differing definitions of diabetes; the NHANES IV workforce study determined diabetes based on fasting blood glucose levels (6). However, a previous study found that the incidence of diabetes in the military is consistent with the incidence in a nonmilitary population (2), so the lower prevalence is likely due to pre-enlistment screening that excludes potential applicants who have already developed diabetes or have risk factors that can lead to diabetes, including an elevated body mass index. Additionally, uncontrolled diabetes is grounds for medical discharge from the USAF; some members with diabetes may have been unaccounted for by our study for this reason.

Although we found that the overall prevalence of diabetes was lower for all race/ethnicity groups than what was reported for the US population (6), the disparity for non-Hispanic blacks and Hispanics in our population is similar to what has been reported in prior studies of military (2) and nonmilitary (7) populations. However, in this sample, American Indian/Alaska Native members demonstrated a lower prevalence of diabetes compared with non-Hispanic whites. This finding is not consistent with previously published studies outside of the military (7). Pre-enlistment screening may exclude American Indian/Alaska Native members who are at higher risk for developing diabetes or these members may be more likely to develop uncontrolled diabetes and to be medically discharged; however, possible causes were beyond the scope of this study.

Prevalence of asthma in our study population was 0.9%, much lower than the overall prevalence from the Behavior Risk Factor Surveillance System of 7.7% for adults (10). This difference in overall prevalence is likely because asthma diagnosed before age 12 is a disqualification for entry into the military (11).

Despite the higher prevalence of the chronic diseases for racial or ethnic minorities compared with non-Hispanic whites, there is no evidence that that these members are less likely to participate in preventive care activities. In fact, a previous analysis from this population indicated that among active-duty members younger than 30 (more than half the sample), non-Hispanic blacks were significantly more likely to have a current preventive health assessment compared with non-Hispanic whites ($P < .05$) (18).

Outside of the military, racial/ethnic health disparities are attributed to interconnected factors, including racism (19), social and economic factors (20), and access to health care (21). Health literacy, another factor in health disparities, is also associated with poor outcomes but not necessarily with the overall use of health care (22).

The reasons for persistent racial and ethnic disparities in the prevalence of chronic diseases among a prescreened USAF population with equitable health care and living conditions are complex. However, because disparities have been identified outside of the military setting (3), pre-enlistment screening and subsequent health care and community resources likely cannot completely overcome at least 18 years of prior health neglect or culturally ingrained health habits and beliefs. In fact, several recent studies have linked childhood factors to long-term health outcomes; low socioeconomic status and experiencing a high number of adversities during childhood are associated with poor physical capabilities (23) and a high risk of developing diabetes (24).

Targeted interventions are effective at addressing disparities in the prevalence of chronic diseases (25). Just as important, however, is the need to acknowledge the effect of disparities on the overall health of men and women who enlist in the USAF and other military services. A concerted effort to understand and design culturally sensitive prevention efforts is the first step to address these disparities. Tracking existing population health metrics by race/ethnicity may also help to identify problems (and successes) and ensure that health disparities are adequately addressed.

Relying on existing clinical and administrative data has several inherent disadvantages, primarily the inability to completely account for the unique circumstances and risk factors of each person. A factor that should be considered is the overall rate of medical discharges from the military for these chronic diseases; however, these data were not available for analysis or comparison. Also, differences in personal health care–seeking behaviors may directly influence the findings because the diagnosis of these chronic diseases in this study relies on existing data from individual encounters. Some members may have met diagnostic criteria for 1 of the 4 chronic diseases included in this study but avoided screening activities.

We were, however, able to use data collected on every active-duty member in the USAF who met eligibility criteria, and to compare among all race/ethnicity, sex, and rank categories. Therefore, we were not bound by selection bias or a

limited sample size. Our findings provide a reference point for future research examining health outcomes of active-duty military members by race/ethnicity.

The racial and ethnic disparities in the prevalence of the 4 chronic diseases we studied suggest the need to ensure effective preventive health care practices and community outreach efforts for racial/ethnic minorities, particularly non -Hispanic blacks.

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Tables

Table 1. Demographic Characteristics and Prevalence of Chronic Diseases Among All Active-Duty US Air Force Members (N = 284,850),[a] 2008

Return

Characteristic	n (%)
Race/ethnicity	
American Indian/Alaska Native	2,544 (0.9)
Asian/Pacific Islander	13,295 (4.7)
Black, non-Hispanic	41,970 (14.7)
White, non-Hispanic	203,857 (71.6)
Hispanic	16,422 (5.8)
Other/declined to respond	6,762 (2.4)
Sex	
Male	230,579 (80.9)
Female	54,271 (19.0)
Age, y	
21-25	85,881 (30.1)
26-30	70,318 (24.7)
31-35	47,999 (16.9)
36-40	43,519 (15.3)
≥41	37,133 (13.0)
Rank category	

Characteristic	n (%)
Junior enlisted (E1-E4)	89,377 (31.4)
Senior enlisted (E5-E9)	132,821 (46.6)
Junior officer (O1-O3)	35,500 (12.5)
Senior officer (O4-O6)	26,032 (9.1)
Other (eg, special agent)	1,120 (0.4)
Chronic diseases[b]	
Hypertension	15,128 (5.3)
Dyslipidemia	12,987 (4.6)
Diabetes	892 (0.3)
Asthma	2,477 (0.9)

[a] Aged ≥21 and on active duty ≥12 months (excluding officers with the rank of general).
[b] Defined by the presence of appropriate *International Classification of Diseases, Ninth Revision, Clinical Modification* codes in the medical record for the preceding 2 years (12).

Table 2. Prevalence of Chronic Diseases, by Race/Ethnicity, Among Active-Duty US Air Force Members, 2008[a]

Return

Chronic Disease[b]/Age	Non-Hispanic White, % (95% CI) (n = 203,015)	American Indian/Alaska Native, % (95% CI) (n = 2,533)	Asian/Pacific Islander, % (95% CI) (n = 13,253)	Non-Hispanic Black, % (95% CI) (n = 41,861)	Hispanic, % (95% CI) (n = 16,339)
Hypertension					
21-25 y	0.98 (0.98-0.99)	1.22 (1.19-1.25)	0.86 (0.86-0.87)	1.87 (1.86-1.89)	0.81 (0.80-0.83)
26-30 y	2.24 (2.23-2.25)	2.67 (2.59-2.75)	2.03 (2.00-2.07)	4.84 (4.81-4.88)	1.98 (1.96-1.99)
31-35 y	4.22 (4.21-4.24)	5.42 (5.23-5.62)	5.51 (5.41- 5.61)	9.53 (9.46-9.61)	4.17 (4.12-4.22)
36-40 y	8.15 (8.12-8.19)	10.02 (9.61-10.42)	10.96 (10.74-11.18)	17.61 (17.48-17.75)	8.14 (8.03-8.26)
≥41 y	12.92 (12.87-12.98)	14.75 (14.23-15.27)	18.3 (17.93-18.66)	27.6 (27.41-27.79)	14.31 (14.06-14.57)
Overall	4.57 (4.55-4.59)	4.5 (4.32-4.68)	4.62 (4.52-4.72)	9.57 (9.48-9.66)	4.33 (4.26-4.41)
Dyslipidemia					
21-25 y	0.55 (0.55-0.55)	0.76 (0.74-0.79)	0.80 (0.79-0.81)	0.65 (0.64-0.65)	0.76 (0.75-0.77)
26-30 y	1.64 (1.64-1.65)	2.2 (2.13-2.27)	2.24 (2.21-2.27)	1.82 (1.80-1.83)	1.98 (1.95-2.00)
31-35 y	4.14 (4.12-4.16)	5.52 (5.27-5.77)	5.42 (5.31-5.52)	4.54 (4.49-4.59)	4.73 (4.66-4.80)
36-40 y	8.46 (8.42-8.49)	11.54 (11.03-12.04)	11.23 (10.99-11.48)	9.52 (9.42-9.62)	9.79 (9.64-9.95)
≥41 y	13.89 (13.83-13.95)	18.46 (17.66-19.25)	18.8 (18.42-19.17)	15.49 (15.33-15.64)	16.25 (15.99-16.50)

Chronic Disease[b]/Age	Non-Hispanic White, % (95% CI) (n = 203,015)	American Indian/Alaska Native, % (95% CI) (n = 2,533)	Asian/Pacific Islander, % (95% CI) (n = 13,253)	Non-Hispanic Black, % (95% CI) (n = 41,861)	Hispanic, % (95% CI) (n = 16,339)
Overall	4.46 (4.44-4.49)	4.74 (4.50-4.98)	4.72 (4.61-4.82)	4.83 (4.77-4.89)	4.87 (4.79-4.96)
Diabetes					
21-25 y	0.04 (0.04-0.04)	0	0.01 (0.01-0.01)	0.06 (0.06-0.06)	0.10 (0.10-0.10)
26-30 y	0.08 (0.08-0.08)	0	0.03 (0.03-0.04)	0.13 (0.12-0.13)	0.12 (0.11-0.12)
31-35 y	0.16 (0.16-0.16)	0.02 (0.02-0.03)	0.18 (0.18-0.19)	0.46 (0.46-0.47)	0.30 (0.29-0.31)
36-40 y	0.40 (0.40-0.40)	0.64 (0.58-0.69)	1.22 (1.17-1.26)	1.31 (1.29-1.32)	0.92 (0.90-0.94)
≥41 y	0.82 (0.81-0.83)	1.31 (1.24-1.39)	2.87 (2.78-2.96)	2.30 (2.28-2.33)	1.68 (1.64-1.71)
Overall	0.23 (0.23-0.23)	0.20 (0.18-0.22)	0.43 (0.41-0.45)	0.62 (0.61-0.63)	0.43 (0.42-0.44)
Asthma					
21-25 y	0.41 (0.41-0.41)	0.42 (0.40-0.43)	0.44 (0.44-0.45)	0.63 (0.63-0.64)	0.55 (0.55-0.56)
26-30 y	0.61 (0.60-0.61)	0.65 (0.62-0.67)	0.66 (0.65-0.67)	1.02 (1.01-1.03)	0.81 (0.80-0.82)
31-35 y	0.96 (0.95-0.96)	1.05 (1.00-1.11)	1.02 (1.00-1.05)	1.55 (1.53-1.57)	1.22 (1.20-1.23)
36-40 y	1.22 (1.21-1.23)	1.27 (1.20-1.33)	1.31 (1.28-1.34)	1.96 (1.94-1.99)	1.53 (1.50-1.56)
≥41 y	1.23 (1.22-1.24)	1.26 (1.19-1.34)	1.28 (1.25-1.32)	1.87 (1.85-1.89)	1.46 (1.43-1.49)
Overall	0.79 (0.78-0.79)	0.75 (0.73-0.77)	0.77 (0.76-0.78)	1.24 (1.23-1.25)	1.00 (0.99-1.01)

Abbreviation: CI, confidence interval.
[a] Adjusted for sex and rank.
[b] Defined by the presence of appropriate *International Classification of Diseases, Ninth Revision, Clinical Modification* codes in the medical record for the preceding 24 months (12).

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ORIGINAL RESEARCH

Health-Related Quality of Life Among US Veterans and Civilians by Race and Ethnicity

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PEER REVIEWED

Abstract

Introduction
Among veterans, having been selected into the military and having easy access to medical care during and after military service may reduce premature mortality but not morbidity from mental distress and may not improve health-related quality of life. The objective of this study was to determine whether veterans in different racial/ethnic groups differ in their health-related quality of life from each other and from their civilian counterparts.

Methods
Among 800,000 respondents to the 2007–2009 Behavioral Risk Factor Surveillance System surveys, approximately 110,000 identified themselves as veterans and answered questions about their sociodemographic characteristics, self-rated health, and recent health-related quality of life. Nonoverlapping 95% confidence intervals of means distinguished veterans and civilians of different racial/ethnic groups.

Results
Veteran and civilian American Indians/Alaska Natives reported more physically unhealthy days, mentally unhealthy days, and recent activity limitation days than their veteran and civilian counterparts in other racial/ethnic groups. Non-Hispanic white veterans and Hispanic veterans reported more physically unhealthy days, mentally unhealthy days, and recent activity limitation days than their civilian counterparts.

Conclusion
Unlike findings in other studies, our findings show that veterans' health-related quality of life differs from that of civilians both within the same racial/ethnic group and among different racial/ethnic groups. Because once-healthy soldiers may not be as healthy when they return to civilian life, assessing their health-related quality of life over time may identify those who need help to regain their health.

Introduction

Each soldier's experience in the military is unique, whether the soldier volunteered or was drafted into military service (1). After being selected, completing basic training, and going off to their assignments, all soldiers have the common experience that they are generally healthier than those excluded from military service (2). Preliminary screening disqualifies those who are less physically and psychologically fit, remaining in the service requires meeting physical and psychological standards, and accessing medical care is easier during and after military service. This "healthy soldier" effect may reduce premature mortality among soldiers compared with their nonsoldier peers even after military service has ended.

This benefit of reduced premature mortality for soldiers may not carry over to reduced morbidity from mental distress and improved health-related quality of life (HRQOL) (3-5). Overall quality of life involves individual and subjective evaluations of the positive and negative aspects of life based on one's values and culture and includes who one is (part of a family, health, function), what one does (cares for others, works, goes to school), and where one lives (community, nation) (6). HRQOL is that part of overall quality of life that affects physical and mental health (7,8). HRQOL includes a person's perceptions of his or her physical and mental health, which results from health risks, conditions, functional

status, socioeconomic status, and social support. For example, HRQOL in the general US population varies by sociodemographic characteristics including race/ethnicity, risky behaviors, reported chronic health conditions, activity limitation, and social support (9-19).

Previous studies have examined the HRQOL of veterans with mixed results (20-23). Some studies compared HRQOL among active duty, reserve, and veteran military personnel with that of those with no military service without directly analyzing HRQOL by race/ethnicity (20-22). Another study compared scores on the Medical Outcomes Study Short Form 36-item Survey for Veterans for active duty and Reserve/National Guard military personnel by race/ethnicity to US normative scale scores (23). However, none of these studies has analyzed racial/ethnic differences in HRQOL of representative samples of veterans and their nonveteran civilian counterparts. The objective of this study was to determine whether veterans in different racial/ethnic groups differ in their HRQOL from each other (primary) and from their civilian counterparts (secondary).

Methods

This study is a descriptive analysis of cross-sectional data from respondents to the 2007–2009 surveys of the Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is an annual random-digit–dialed telephone survey in all 50 US states, the District of Columbia, Puerto Rico, the Virgin Islands, and the US Pacific territories (24). Eligible participants are adults (1 per household) aged 18 years or older interviewed about their health status, access to health care, and health behaviors. The Centers for Disease Control and Prevention (CDC) institutional review board has reviewed and approved the BRFSS protocol. The BRFSS method, design, questionnaires, and data sets are available in the public domain (24).

Sample

Of 1,278,028 participants in the 2007–2009 BRFSS, 801,862 (63%) answered a question about their status as a veteran (see definition below) and identified themselves as either non-Hispanic whites, non-Hispanic blacks, American Indians/Alaska Natives, or Hispanics. Twelve percent (n = 110,365) of these reported being a veteran, 100,829 (92%) men and 9,536 (8%) women (values are weighted). We compared veterans and their civilian counterparts within racial/ethnic groups by age, marital status, educational level, employment status, annual income, and HRQOL.

Measures

The HRQOL items used for this study were self-rated health (excellent, very good, good, fair, or poor), physically unhealthy days (the number of days during the past 30 days when one's physical health was not good), mentally unhealthy days (the number of days during the past 30 days when one's mental health was not good), and recent activity limitation days (the number of days during the past 30 days when one's physical or mental health kept one from doing one's usual activities). The question about veteran status remained the same during the 2007–2009 BRFSS surveys: "Have you ever served on active duty in the United States Armed Forces, either in the regular military or in a National Guard or military reserve unit? Active duty does not include training for the Reserves or National Guard, but DOES include activation, for example, for the Persian Gulf War." However, the response choices differed in the 2009 questionnaires from those in the 2008 and 2007 questionnaires. In 2009, participants chose from 7 responses: 1) yes, now on active duty; 2) yes, on active duty during the last 12 months, but not now; 3) yes, on active duty in the past, but not during the last 12 months; 4) no, training for Reserves or National Guard only; 5) no, never served in the military; 6) don't know/not sure; and 7) refused. In the 2007 and 2008 BRFSS, there were 4 choices: yes, no, don't know/not sure, and refused. For this study, we defined veterans as those answering yes to these questions on any of the 3 surveys and civilians as those answering no to these questions. We excluded from the analysis those answering don't know/not sure and those refusing to answer these questions.

The demographic characteristics analyzed were the following: race/ethnicity (non-Hispanic white, non-Hispanic black, American Indian/Alaska Native, or Hispanic); age group (18–24, 25–34, 35–44, 45–54, 55–64, or ≥65 y), marital status (currently married or not), educational level (≤high school, attended college or technical school, or graduated from college or technical school), employment status (currently employed for wages or self-employed, not currently employed [includes the unemployed, students, homemakers, or unable to work], or retired), and annual household income (<$15,000, $15,000–$24,999, $25,000–$34,999, $35,000–$49,999, or ≥$50,000).

Statistical analysis

To account for the BRFSS complex sample design and sampling weights, we used SAS-callable SUDAAN version 9.2 (RTI International, Research Triangle Park, North Carolina) to estimate demographic characteristics and self-rated health and mean unhealthy days by veteran status and race/ethnicity, both unadjusted and adjusted for sex, age group, marital status, educational level, employment status, and annual household income. Nonoverlapping 95% confidence intervals of means statistically distinguished veterans and civilians of different racial/ethnic groups.

Results

Women were more likely than men to be civilians, although non-Hispanic black and Hispanic women were more likely than non-Hispanic white women to be veterans (Table 1). Hispanic veterans usually reported their health as being better than that of their civilian counterparts, non-Hispanic blacks and American Indian/Alaska Native veterans as about the same, and non-Hispanic white veterans as being worse; non-Hispanic white civilians generally reported their health as better than that of civilians in other racial/ethnic groups.

American Indian/Alaska Native veterans reported more physically unhealthy days and recent activity limitation days than veterans in other racial/ethnic groups (Table 2). American Indian/Alaska Native civilians said they had more physically unhealthy days, mentally unhealthy days, and recent activity limitation days than civilians in other racial/ethnic groups. American Indian/Alaska Native veterans and non-Hispanic white veterans described themselves as having more physically unhealthy days and non-Hispanic white veterans reported more recent activity limitation days than their civilian counterparts. Non-Hispanic white and black veterans reported fewer mentally unhealthy days than their civilian counterparts.

After adjusting for sex, age, marital status, educational level, employment status, and annual household income, American Indian/Alaska Native veterans still reported more physically unhealthy days and recent activity limitation days than veterans in other racial/ethnic groups (Table 2). American Indian/Alaska Native civilians still said they had more physically unhealthy days, mentally unhealthy days, and recent activity limitation days than civilians in other racial/ethnic groups. Veterans in all racial/ethnic groups reported more physically unhealthy days than their civilian counterparts, but only non-Hispanic white and Hispanic veterans said they had more mentally unhealthy days and recent activity limitation days than their civilian counterparts.

Discussion

This study explored differences in the associations between the HRQOL of veterans and civilians by racial/ethnic group. Despite the “healthy soldier” effect, other studies have documented poorer mental and physical health in some veterans, which might be expected to affect their health perceptions or HRQOL (3-5,25-27). Yet, in none of these studies was race or ethnicity associated with poorer mental and physical health after accounting for other potentially confounding variables. In this study, however, the HRQOL of veterans differed from that of their civilian counterparts both within the same racial/ethnic group and among different racial/ethnic groups. What happened to these veterans during or after military service may have affected these differences in their current HRQOL. The higher number of mean physically unhealthy days among veterans of all racial/ethnic groups compared with that of their civilian counterparts, even after adjustment, may indicate persistent effects of physical trauma associated with military service (28). Veterans who belonged to racial/ethnic groups that may be discriminated against more often, American Indians/Alaska Natives and non-Hispanic blacks, did not differ from their civilian counterparts with respect to their mental or activity-limiting HRQOL, perhaps because discrimination against these groups after military service affects these aspects of HRQOL more than military service alone (29,30). However, veterans who belong to racial/ethnic groups that may be less discriminated against, non-Hispanic whites and Hispanics, still reported worse mental and activity-limiting HRQOL than their civilian counterparts, suggesting that military service can affect these aspects of HRQOL.

Compared with these other studies, our study had several strengths. It analyzed HRQOL in different racial/ethnic groups and had sizable numbers of respondents in these groups, allowing for the adjustment of potentially confounding sociodemographic characteristics. The BRFSS questions on HRQOL have acceptable validity and reliability (7,9). Because these HRQOL questions preceded those asking about veterans status, the ascertainment of status as a veteran probably did not affect responses about HRQOL.

This study also had several limitations. Because BRFSS depends on self-reported experiences, we could not corroborate reports of veteran status, although respondents would not benefit from falsely reporting themselves as veterans or denying they were veterans. Moreover, HRQOL is inherently subjective, and we could not corroborate differences in HRQOL with objective indicators of health and functional status (eg, physician records of diagnosed disease, hospitalizations) that affect HRQOL. Because the questions in the 2007–2009 BRFSS do not distinguish between participation in the military and exposure to combat and do not ask about duration of military service (www.cdc.gov/brfss/), we could not tell whether exposure to combat and duration of military service affected the observed differences in HRQOL among the different racial/ethnic groups of veterans. Moreover, because BRFSS is cross-sectional, we could not tell whether the observed differences in HRQOL between veterans and civilians occurred because of events during military service or afterward. The small number of women veterans in some racial/ethnic groups precluded comparison of their HRQOL with that of their civilian counterparts. Until recently, BRFSS has been based on landline residential telephones and excludes US adults who use only cell phones and whose sociodemographic characteristics and responses to BRFSS may differ from those who use landline residential telephones.

The HRQOL differences in this study between veterans and their civilian counterparts and among veterans in different racial/ethnic groups may indicate persistent health problems associated with military service, persistent discrimination against certain racial/ethnic groups despite their military service, or both. Because once-healthy soldiers may not be as healthy when they return to civilian life, assessing their HRQOL over time may identify those who need help to regain their health.

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Tables

Table 1. Characteristics of Veterans and Civilians by Race/Ethnicity, Behavioral Risk Factor Surveillance System, 2007–2009[a]

Return

Characteristics	Veterans (n = 110,365)				Civilians (n = 691,497)			
	Non-Hispanic White	Non-Hispanic Black	American Indian/ Alaska Native	Hispanic	Non-Hispanic White	Non-Hispanic Black	American Indian/ Alaska Native	Hispanic
	% (95% CI)							
Female	7 (6-8)	12 (11–14)	9 (6-13)	10 (8-13)	59 (58–60)	60 (59–62)	54 (51–57)	52 (50–53)

Characteristics	Veterans (n = 110,365)				Civilians (n = 691,497)			
	Non-Hispanic White	Non-Hispanic Black	American Indian/ Alaska Native	Hispanic	Non-Hispanic White	Non-Hispanic Black	American Indian/ Alaska Native	Hispanic
	% (95% CI)							
Age group, y								
18–24	2 (1-3)	3 (2-5)	4 (1-9)	6 (4-9)	11 (10–12)	14 (13–16)	19 (16–23)	19 (17–20)
25–34	7 (6-8)	12 (10–15)	8 (4-14)	18 (15–22)	17 (17–18)	21 (20–22)	20 (18–23)	27 (26–28)
35–44	12 (11–13)	23 (20–26)	15 (11–20)	18 (15–21)	20 (19–20)	21 (20–22)	19 (17–21)	23 (22–24)
45–54	14 (13–14)	23 (20–25)	19 (15–24)	16 (14–19)	21 (20–22)	19 (17–20)	19 (17–21)	15 (14–16)
55–64	24 (23–25)	19 (17–21)	27 (22–32)	17 (15–20)	15 (14–15)	13 (12–14)	13 (11–14)	9 (8-10)
≥65	41 (40–42)	20 (18–22)	27 (22–33)	25 (22–28)	16 (16–17)	12 (11–13)	10 (9-12)	8 (7-9)
Married	75 (74–76)	59 (57–62)	61 (54–67)	69 (65–72)	63 (62–64)	37 (36–39)	47 (44–50)	54 (52–55)
Education								
High school diploma or less	34 (33–35)	35 (32–37)	38 (33–44)	35 (31–38)	36 (35–36)	49 (48–50)	55 (53–58)	64 (63–65)
Some college or technical school	30 (29–31)	38 (35–40)	34 (28–40)	37 (33–40)	27 (26–28)	27 (26–29)	27 (24–30)	20 (19–21)
Graduated from college or technical school	37 (35–38)	28 (25–30)	28 (22–34)	29 (25–32)	38 (37–38)	24 (23–25)	18 (16–20)	16 (15–17)
Employment								
Employed	49 (48–50)	57 (55–60)	49 (43–55)	60 (56–63)	63 (62–63)	58 (56–59)	55 (52–57)	61 (59–62)
Not employed	9 (8-10)	18 (15–20)	17 (13–22)	14 (11–17)	22 (22–23)	30 (29–32)	35 (32–37)	33 (32–35)
Retired	42 (41–43)	25 (23–27)	34 (29–40)	27 (24–30)	15 (14–16)	12 (11–13)	11 (9-12)	6 (5-7)
Annual household income, $								
<15,000	5 (4-5)	9 (7-11)	13 (9-17)	10 (8-13)	7 (6-7)	17 (16–18)	18 (15–21)	22 (21–23)
15,000–24,999	13 (12–14)	15 (13–17)	19 (14–24)	15 (12–18)	12 (11–13)	23 (22–24)	24 (21–26)	28 (26–29)
25,000–34,999	12 (11–13)	13 (11–15)	16 (11–21)	12 (10–15)	10 (9-11)	15 (14–16)	14 (12–16)	15 (13–16)
35,000–49,999	18 (17–19)	20 (18–23)	17 (12–22)	17 (14–20)	15 (14–15)	15 (14–16)	15 (12–17)	13 (12–14)
≥50,000	53 (52–54)	43 (40–46)	36 (30–43)	46 (42–50)	57 (56–57)	30 (29–32)	30 (28–33)	22 (21–24)
Self-rated health								
Excellent	18 (17–19)	18 (16–21)	16 (12–21)	22 (19–26)	22 (22–23)	17 (16–18)	17 (15–20)	17 (15–18)

Characteristics	Veterans (n = 110,365)				Civilians (n = 691,497)			
	Non-Hispanic White	Non-Hispanic Black	American Indian/ Alaska Native	Hispanic	Non-Hispanic White	Non-Hispanic Black	American Indian/ Alaska Native	Hispanic
	% (95% CI)							
Very good	32 (31–33)	27 (24–29)	23 (18–28)	28 (24–31)	37 (36–38)	26 (25–28)	25 (22–28)	20 (19–22)
Good	31 (30–32)	34 (31–36)	34 (28–40)	30 (27–33)	28 (27–29)	36 (34–37)	34 (31–37)	37 (35–38)
Fair	13 (12–14)	15 (13–17)	15 (11–19)	14 (12–17)	9 (9-10)	16 (14–17)	15 (13–17)	22 (20–23)
Poor	6 (5-7)	6 (4-8)	13 (9-17)	6 (5-9)	4 (3-4)	6 (5-6)	9 (7-10)	5 (4-6)

Abbreviation: CI, confidence interval.
[a] Percentages and their 95% confidence intervals (CIs) are based on a weighted analysis to account for the survey's complex sample design.

Table 2. Unadjusted[a] and Adjusted[b] Mean Unhealthy Days for Veterans and Civilians by Race/Ethnicity, Behavioral Risk Factor Surveillance System, 2007–2009

Return

Measure	Non-Hispanic White		Non-Hispanic Black		American Indian/Alaska Native		Hispanic	
	Veterans	Civilians	Veterans	Civilians	Veterans	Civilians	Veterans	Civilians
	Mean (95% CI)							
Physically unhealthy days								
Unadjusted	4.2 (4.1–4.4)	3.4 (3.4–3.5)	4.4 (3.9–4.9)	3.9 (3.7–4.0)	7.3 (5.9–8.6)	5.3 (4.9–5.7)	4.2 (3.6–4.7)	3.6 (3.5–3.8)
Adjusted	4.1 (3.9–4.2)	3.7 (3.6–3.8)	4.0 (3.5-4.5)	3.2 (3.0–3.3)	6.7 (5.3–8.1)	4.7 (4.2–5.1)	4.1 (3.5–4.7)	2.8 (2.6–3.0)
Mentally unhealthy days								
Unadjusted	2.6 (2.4–2.7)	3.4 (3.3–3.5)	3.3 (2.9–3.7)	4.0 (3.8–4.1)	3.8 (2.9–4.7)	5.1 (4.7–5.6)	3.0 (2.6–3.4)	3.6 (3.4–3.7)
Adjusted	4.0 (3.8–4.1)	3.6 (3.5–3.7)	3.6 (3.2–4.1)	3.1 (2.9–3.3)	4.2 (3.3–5.1)	4.3 (3.8–4.7)	3.7 (3.2–4.2)	2.4 (2.2–2.6)
Recent activity limitation days								
Unadjusted	2.5 (2.4–2.6)	2.1 (2.0–2.2)	2.9 (2.4–3.3)	2.6 (2.4–2.7)	4.7 (3.6–5.8)	3.9 (3.5–4.3)	2.6 (2.1–3.1)	2.1 (2.0–2.3)
Adjusted	2.6 (2.5–2.8)	2.3 (2.2–2.4)	2.6 (2.1–3.0)	2.0 (1.8–2.1)	4.4 (3.2–5.5)	3.3 (2.9–3.7)	2.6 (2.1–3.1)	1.4 (1.2–1.5)

Abbreviation: CI, confidence interval.
[a] Means and their 95% confidence intervals (CIs) are based on a weighted analysis to account for the survey's complex sample design.
[b] Means and their 95% CIs are weighted to account for the survey's complex sample design and adjusted for sex, age group, marital status, educational level, employment status, and annual household income.

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ORIGINAL RESEARCH

Evaluation of a Weight Management Program for Veterans

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PEER REVIEWED

Abstract

Introduction
To improve the health of overweight and obese veterans, the Department of Veterans Affairs (VA) developed the MOVE! Weight Management Program for Veterans. The aim of this evaluation was to assess its reach and effectiveness.

Methods
We extracted data on program involvement, demographics, medical conditions, and outcomes from VA administrative databases in 4 Western states. Eligibility criteria for MOVE! were being younger than 70 years and having a body mass index (BMI, in kg/m^2) of at least 30.0, or 25.0 to 29.9 with an obesity-related condition. To evaluate reach, we estimated the percentage of eligible veterans who participated in the program and their representativeness. To evaluate effectiveness, we estimated changes in weight and BMI using multivariable linear regression.

Results
Less than 5% of eligible veterans participated, of whom half had only a single encounter. Likelihood of participation was greater in women, those with a higher BMI, and those with more primary care visits, sleep apnea, or a mental health condition. Likelihood of participation was lower among those who were younger than 55 (vs 55-64), widowed, current smokers, and residing farther from the medical center (≥30 vs <30 miles). At 6- and 12-month follow-up, participants lost an average of 1.3 lb (95% confidence interval [CI], −2.6 to −0.02 lb) and 0.9 lb (95% CI, −2.0 to 0.1 lb) more than nonparticipants, after covariate adjustment. More intensive treatment (≥6 encounters) was associated with greater weight loss at 12 months (−3.7 lb; 95% CI, −5.1 to −2.3 lb).

Conclusion
Few eligible patients participated in the program during the study period, and overall estimates of effectiveness were low.

Introduction

An estimated 70% of veterans are overweight or obese, with a body mass index (BMI, in kg/m^2) of 25.0 or more, consistent with the prevalence of overweight and obesity among demographically similar nonveterans (1-4). Weight loss as small as 5% can reduce the risk of chronic conditions associated with obesity (5). Participants in intensive lifestyle interventions such as those tested in the Diabetes Prevention Program and the Look Ahead trials achieved clinically significant weight loss (6,7). Mean weight losses in those trials were approximately 7% to 8% at 1 year, or 19 pounds (6,7). Translating these successful interventions into programs that can be disseminated widely and implemented in clinical and community settings is a key to reducing the prevalence of obesity.

The Department of Veterans Affairs (VA) administers the largest integrated health care system in the United States; it includes 152 medical centers and 804 community-based outpatient clinics (8). More than 8 million men and women were enrolled in the VA Health Care System in 2010, and approximately 6 million of them received health care in this

system (8). To improve the care of veterans who are obese and overweight, VA created and disseminated a clinic-based weight management program, the MOVE! Weight Management Program for Veterans, beginning in 2005.

MOVE! is the largest clinically based weight management program in the United States. Little is known about the proportion of eligible VA patients ("candidates") who participate in the program, the characteristics of participants, or the program's effectiveness. The primary aims of this study were to 1) estimate participation in the program, including comparisons of veterans who did and did not participate, and 2) assess the program's effectiveness in terms of weight change. Secondary aims were to evaluate effectiveness in subgroups and assess implementation and adoption of the program.

Methods

We conducted an evaluation of the program in 1 of the 21 regional VA networks and used the RE-AIM framework (reach, effectiveness, adoption, implementation, and maintenance) for organizing our analysis, results, and interpretation, focusing mainly on reach and effectiveness (9). This framework emphasizes that for a program to be effective in the general population, evaluation of components other than efficacy is important.

The MOVE! Weight Management Program for Veterans

The VA National Center for Health Promotion and Disease Prevention (NCP) developed MOVE! to provide a standardized format for weight management (10). NCP created the program and materials on the basis of published evidence and clinical practice guidelines from VA and non-VA committees and organizations, as well as other published studies (5,7,10-12).

To disseminate the program, NCP created handouts for patients, training modules for staff, curricula for group sessions, weight management assessment tools, and methods for electronic tracking of participation in program activities (10). Each facility was permitted to determine its own methods to identify patients for the program and the types and extent of offerings in the program.

The treatment components were intended to be individually tailored, integrated into each patient's ongoing care, and implemented in clinics by multidisciplinary teams (eg, dietitians, physical and recreational therapists, social workers, and mental health professionals). Typically, during the first encounter, staff provide an overview of the program and instruct patients to complete a 23-item questionnaire on their diet, physical activity, health status, and prior weight loss attempts. An individualized report is then generated; it includes a list of recommended print-ready materials on nutrition, physical activity, and healthy behavior change available from the MOVE! website (www.move.va.gov/). MOVE! staff may also help patients set goals to change diet and physical activity at this initial encounter. Follow-up sessions may be group-based, one-on-one, or by telephone.

Pilot feasibility trials were conducted at 17 VA medical centers between October 2003 and December 2004. On the basis of lessons learned in the pilot testing, NCP revised the program components and materials and launched the program nationally in late 2005. VA leadership issued formal policy in early 2006 requiring weight management treatment to be available at all VA medical facilities (http://vaww.move.med.va.gov/).

Data sources

Because there was no data source for national estimates of key variables, we performed these analyses using data from the VA Northwest Region database (Veterans Integrated Service Network [VISN 20]), which includes data on demographics vital signs, pharmacy use, and laboratory tests and clinical and administrative medical record data about use of outpatient and inpatient services. We obtained information on MOVE! participation and encounter type (ie, group, individual, or telephone) from the National Patient Care Database, which integrates enterprise-wide, patient-level administrative data related to the program. The institutional review boards of VA Puget Sound Health Care System and Portland VA Medical Center approved the study.

Study population

We included patients who had a primary care encounter during the study period at any of the 8 VISN 20 facilities in Alaska, Idaho, Oregon, and Washington State (Figure). "Facility" refers to the main VA hospital and any affiliated satellite hospitals or community-based outpatient clinics (CBOCs); the number of patients at CBOCs was generally too small to analyze separately. For the cross-sectional (reach) analyses, the study period was between October 1, 2005, or the start of MOVE! implementation at each facility, whichever was later, and September 31, 2008. For the longitudinal (effectiveness) analyses, follow-up was until December 31, 2008, the most recent data available when this study was initiated. Because 1 facility did not launch a program until 2009, patients from this facility were excluded from all analyses. Two other facilities began program enrollment late in the study period and thus had few enrollees and limited follow-up time. Consequently, patients from these 2 facilities were considered for inclusion for the cross-sectional analyses only.

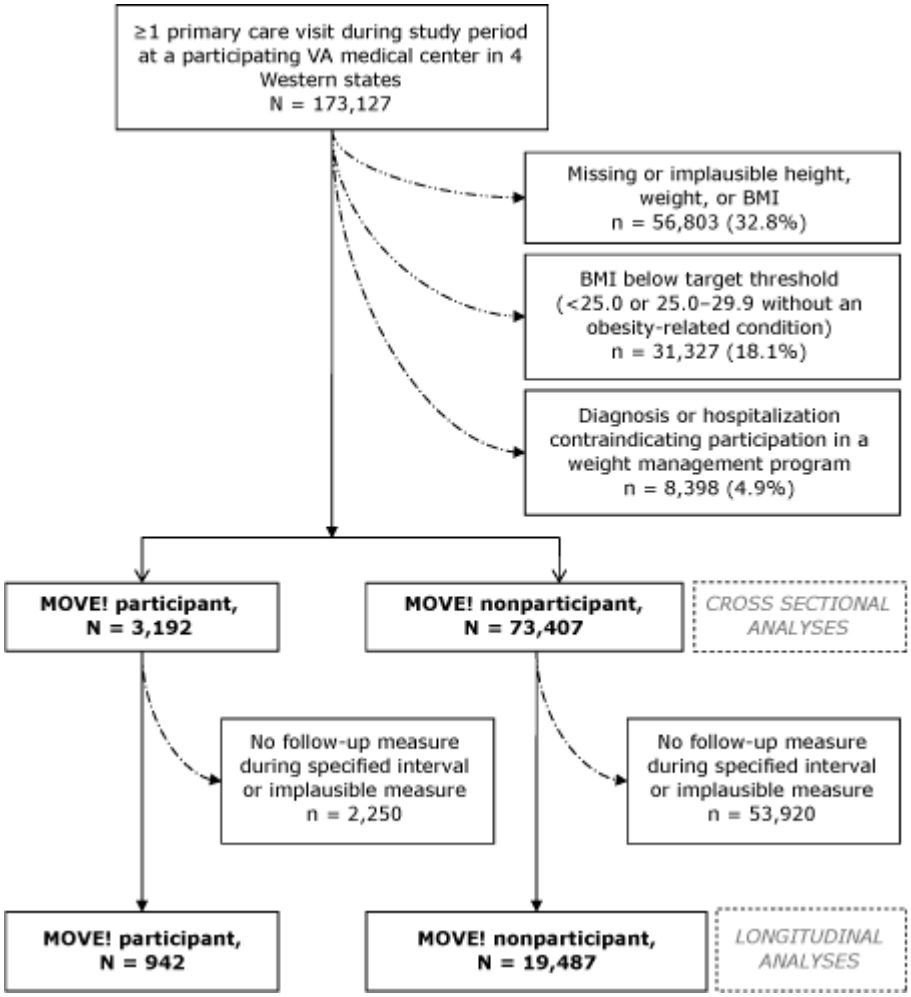

Figure. Flow diagram of VA Northwest patients included in cross-sectional and longitudinal analyses of the MOVE! Weight Management Program for Veterans. Visit had to be between October 1, 2005, or the patient's facility's initial MOVE! implementation date, whichever was later, and September 31, 2008. Participation was limited to patients aged 18 to 69. "Implausible" defined as <75 lb or >600 lb or an average weight loss or gain of >2 lb/wk *and* >50 lb overall, *or* >100 lb gain or loss, regardless of rate of change. "Contraindication" defined in Appendix. Numbers presented in the figure are for 12-month weight changes; numbers for 6-month weight changes were 951 participants and 17,139 nonparticipants. Abbreviation: BMI, body mass index. [A text description of this figure is also available.]

To identify patients who were MOVE! candidates, we used BMI derived from heights and weights obtained during routine clinical encounters. We attempted to use heights measured during the same period as weights but used heights recorded as far back as January 1997. We used an iterative process to eliminate height, weight, and BMI measures that reflected probable data entry errors (Appendix).

Patients were considered candidates for MOVE! if they 1) had a BMI of at least 30.0, or 25.0 to 29.9 with an obesity-related condition and 2) were younger than 70 (because the program was not designed for older people). We excluded patients who had a medical condition that contraindicated weight management (Appendix). Patients were classified as participants if they had at least 1 encounter coded as related to MOVE!. Nonparticipants were defined as MOVE! candidates who had no MOVE!-related encounters.

Assessment and statistical analyses of reach

We defined reach as the proportion of candidate veterans who participated in MOVE!. Representativeness was based on comparisons of participants to nonparticipants for key sociodemographic and health-related characteristics. To determine the independent associations between characteristics and participation, we created a multivariable logistic regression model.

Assessment and statistical analyses of effectiveness

We attempted to obtain weights at the most relevant period while minimizing the number of patients dropped from analyses. For the longitudinal analyses, baseline weight for nonparticipants was the first recorded weight after program implementation at the patient's facility (or a weight recorded up to 30 days prior) and for participants, a weight measured on the day of the patient's first MOVE! encounter or up to 30 days prior.

For each person, we selected the weight closest to 183 and 365 days, respectively, after baseline for the 6-month and 12 -month follow-up outcome measures. The range for the 6-month measures was 84 to 213 days (median: 168 and 169 days for nonparticipants and participants, respectively) and for the 12-month measures was 214 to 395 days (median: 349 and 350 days for nonparticipants and participants, respectively). We considered 12 weeks the minimum time necessary to result in meaningful changes in weight and thus the earliest follow-up time for the 6-month longitudinal analyses.

To compare changes in outcomes between participants and nonparticipants, we used multivariable linear regression. The follow-up values were included as the outcome and adjusted for the baseline measure and the duration of follow-up (in days), in addition to all factors significantly associated with participation. In our primary analyses, we evaluated participation as a dichotomous variable (yes/no). As a secondary analysis, we evaluated participation in terms of "intensity/dose" (ie, nonparticipation vs 1, 2 to 5, and ≥6 MOVE! encounters). Finally, to better understand factors associated with weight loss, we used multivariable logistic regression to determine associations between characteristics and clinically important weight loss in MOVE! participants, defined as at least 5% of baseline weight. Standard errors for multivariable analyses were adjusted for clustering of patients within facilities using a clustered sandwich estimator.

Assessment of other measures

To assess adoption, we calculated the number of facilities that implemented MOVE! in the first year that it was disseminated. As a proxy measure of implementation, we assessed the average number of MOVE! encounters per person and the percentage of patients with only 1 vs 6 or more encounters, at the facility level, in the year following the initial visit.

Results

Reach

Of the 173,127 people who were potentially eligible for MOVE!, 76,599 were classified as MOVE! candidates and included in the cross-sectional analyses (Figure). The primary reasons for exclusion were missing or implausible weight, height, or BMI (n = 56,803); BMI below the threshold for inclusion (n = 31,327); and a diagnosis or hospitalization contraindicating participation in a weight management program (n = 8,398).

A total of 3,192 (4.2%) patients participated in MOVE!, and participation ranged by facility from 0.4% (Facility G) to 8.2% (Facility A) (Table 1). Participation was greater for sites that launched a MOVE! program in April 2006 or earlier.

After adjusting for all factors in Table 2, the following characteristics were associated with likelihood of participation at least 30% higher than the reference categories: female sex, BMI of 30.0 or more, 3 or more primary care visits, sleep apnea, and any mental health condition (including bipolar disorder, depression, or schizophrenia) (Table 2). Age younger than 55 (vs 55–64, the reference category), current smoking, being widowed (vs never married), and receiving care at a facility 30 miles or more from the patient's home were associated with lower likelihood of participation.

Effectiveness

Participants lost approximately 1 to 2 lb (0.2 to 0.3 kg/m^2) during 6 to 12 months of follow-up (Table 3). After multivariable adjustment, mean weight losses in participants were significantly greater than in nonparticipants at 6 months (−1.3 lb) but not 12 months (−0.9 lb). Patients who had 6 or more encounters had significantly greater weight losses at 6-month and 12-month follow-up than nonparticipants (−2.6 lb; 95% CI, −3.8 to −1.5 and −3.7 lb; 95% CI, −5.1 to −2.3, respectively).

There were no consistent associations between facility and clinically important weight loss; for example, although the likelihood of clinically important weight loss at 6 months was approximately 4 times greater at Facility B than Facility D, no such association was apparent for 12-month weight loss. Women (vs men) and those with 2 or more comorbidities (vs none) had a lower likelihood of clinically important weight loss, while greater BMI was associated with higher likelihood of clinically important weight loss.

Implementation

The mean number of encounters during follow-up was 3.0 and varied among facilities (range, 1.6–4.6) (Table 1); 49.6% of participants had only a single encounter (range among facilities, 24.3%–71.9%), while 13.1% had 6 or more

encounters (range among facilities, 0%–31.8%). Additionally, the percentage of encounters that were group-based differed among facilities (0%–95.8%).

Adoption

Five of the 8 VISN 20 facilities launched a MOVE! program by October 2006 (within 12 months of national implementation), whereas 3 facilities did not begin offering MOVE! until at least 2 years after the program was implemented nationally.

Discussion

This study demonstrated that only a small proportion (<5%) of veterans who were candidates for MOVE! participated. Participation was associated with reductions in weight, although the reductions were small and of questionable clinical significance, albeit comparable in magnitude to several other "real world" implementation studies conducted in similar settings (13,14).

Women were more likely to participate than men but were less likely to have clinically important weight loss. BMI was strongly and positively associated with both participation and clinically important weight loss. Although participants had more primary care visits and obesity-related conditions, including sleep apnea, than nonparticipants, participants with more comorbidities were less likely to lose at least 5% of their weight than those with fewer comorbidities or primary care visits. One novel finding was a greater likelihood of participation among veterans with a mental health condition, although there was no evidence of greater effectiveness. People with a mental health condition in the current study also had more obesity-related conditions (eg, heart disease, diabetes, sleep apnea). They may have been viewed by their health care provider as at greater risk for the consequences of obesity, and because of their comorbidities and likely greater contact with health professionals, may have had more opportunities to be offered enrollment in this program. These findings suggest that high-risk participants, such as those with mental health conditions, are interested in weight management. Determining methods to engage them and help them achieve weight management goals is an area for future research.

Evaluating the effectiveness of MOVE! is challenging because it is not clear that the program was implemented as intended. Sustained and intensive treatments are associated with better outcomes (12). Participants in the Diabetes Prevention Program and Look Ahead trials met with interventionists an average of 23.6 and 35.4 times, respectively, in the first year (6,15), nearly an order of magnitude more than was observed for VA Northwest Region patients.

We observed large variability in implementation across facilities. This variability is in part a product of the VA system because decisions on resource allocation are made at the local level. Some facilities in the study region offered only a single educational seminar each month, while other facilities offered 12-session group-based classes 2 or more times per week in addition to ongoing weekly maintenance sessions. Because of the small number of facilities in our study sample and the heterogeneity among them, it was not possible to evaluate associations between facility-level factors and participation or outcomes; other groups are in the process of doing so (16). This area of research may lead to improved reach and effectiveness.

Our study had several limitations. Patients were not randomized into MOVE!. Thus, confounding factors related to motivation to lose weight may explain some or all of the weight loss differences observed. Second, we were unable to assess clinical eligibility for MOVE! or weight change in a large number of patients because of missing data; as a result, participation rates may have been overestimated because many of those without weights and/or heights recorded in the medical record were likely candidates for the program. Conversely, use of administrative databases permitted us to include a large sample of both program participants and nonparticipants and to assess changes in measured rather that self-reported weight. Third, the findings from the Northwest region during the study period may not generalize to other areas of the country because of differences in patients, local implementation, and resources allocated to the program. Fourth, information was not available on weight loss activities unrelated to MOVE!, which may have differed between participants and nonparticipants. Finally, we were limited in our ability to assess other aspects of the RE-AIM framework, including direct measures of implementation, organizational factors, and maintenance (9).

This study focused on evaluation of MOVE! in the first few years after implementation. In 2008, the VA introduced a national overweight/obesity screening performance measure that requires providers to screen patients annually for obesity using BMI, provide obesity risk counseling, and offer comprehensive weight management treatment when appropriate (11). This measure may force facilities to reevaluate and reconfigure their existing MOVE! programs to better serve the increased number of veterans who will be offered treatment.

MOVE! participation in the 4 Western states studied in this evaluation was associated with small weight losses; weight losses were greater and suggested clinically important benefits in patients who received more intensive treatment (ie, ≥6 encounters). Although the findings for more intensive treatment are encouraging, only a small fraction of participants achieved this level of intensity, resulting in a small overall impact of the program. The lack of resources

available to implement the program was likely a major contributing factor to the low participation and the limited evidence of effectiveness (17). Ideally, future evaluations will collect information from a national sample of community -based outpatient clinics and medical centers to determine both facility-level and individual-level factors associated with better outcomes. One benefit of the implementation of widespread screening for obesity in the VA is that it will be possible to assess MOVE! candidacy and effectiveness in a greater proportion of VA patients. Such evaluations will provide valuable information about how to increase the efficacy of the program to improve the health and well-being of overweight and obese veterans.

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Tables

Table 1. MOVE! Program Dates, Participation, and Encounters, by Facility, VA Northwest Region

Return

Measures[a]	Facility						
	A	B	C	D	E	F	G
Month/year MOVE! program began	02/2006	04/2006	10/2005	05/2006[b]	10/2006	10/2007	05/2008
No. of candidate veterans	10,699	8,845	10,777	24,578	7,045	4,357	10,298
MOVE! participants, n (%)	872 (8.2)	587 (6.6)	727 (6.8)	777 (3.2)	170 (2.4)	23 (0.5)	36 (0.4)
No. of encounters, mean (IQR)	4.6 (2–6)	2.2 (1–2)	2.2 (1–3)	1.8 (1–2)	5.9 (2–7)	1.6 (1–2)	NC[c]
Participants with only 1 encounter, %	24.3	60.3	53.2	71.9	24.7	60.9	NC[c]
Participants with ≥6 encounters, %	25.6	9.0	5.5	5.4	31.8	0	NC[c]
Encounters that were group-based, %	20.5	93.1	3.6	72.7	95.7	0	90.1
Encounters that were telephone-based, %	50.7	1.5	1.5	9.0	3.9	0.5	9.4

Abbreviations: VA, Department of Veterans Affairs; IQR, interquartile range; NC, not calculated.
[a] Estimates for enrollment and encounter data were calculated between October 1, 2005, or the date the facility began offering MOVE!, whichever was later, and September 31, 2008.
[b] Estimates are based on data through May 2008 because no patients were coded with MOVE! identifiers between June 1, 2008, and December 31, 2008, because of an error.
[c] Site began offering program <1 year before the end of follow-up; estimates could not be calculated.

Table 2. Characteristics of MOVE! Participants and Eligible Nonparticipants, VA Northwest Region

Return

Characteristic	Nonparticipants (n = 73,407)[a]	Participants (n = 3,192)[a]	Multivariable-Adjusted[b] Associations of Participation, OR (95% CI)
Age, y			
<40	9,595 (13.1)	327 (10.2)	0.6 (0.5–0.7)
40–54	24,239 (33.0)	1,049 (32.9)	0.7 (0.7–0.8)
55–64	30,117 (41.0)	1,399 (43.8)	1 [Reference]
65–69	9,456 (12.9)	417 (13.1)	1.0 (0.9–1.2)
Mean (SD)	53.6 (10.7)	54.7 (9.7)	NA

Characteristic	Nonparticipants (n = 73,407)[a]	Participants (n = 3,192)[a]	Multivariable-Adjusted[b] Associations of Participation, OR (95% CI)
Sex			
Female	5,134 (7.0)	461 (14.4)	1.9 (1.7–2.2)
Male	68,273 (93.0)	2,731 (85.6)	1 [Reference]
Race/ethnicity			
White	43,076 (58.7)	1,826 (57.2)	1 [Reference]
African American	4,283 (5.8)	219 (6.8)	1.2 (1.1–1.5)
Native Hawaiian/Pacific Islander	1,034 (1.4)	40 (1.3)	0.9 (0.7–1.4)
American Indian/Alaska Native	739 (1.0)	24 (0.8)	0.8 (0.5–1.8)
Other/missing	24,275 (33.1)	1,083 (33.9)	1.0 (0.9–1.1)
Facility			
A	9,827 (13.4)	872 (27.3)	2.8 (2.5–3.2)
B	8,258 (11.3)	587 (18.4)	2.3 (2.1–2.7)
C	10,050 (13.7)	727 (22.3)	2.1 (1.8–2.4)
D	23,801 (32.4)	777 (24.3)	1 [Reference]
E	6,875 (9.4)	170 (5.3)	1.1 (0.9–1.3)
F	4,334 (5.9)	23 (0.7)	0.4 (0.3–0.6)
G	10,262 (14.0)	36 (1.1)	0.2 (0.1–0.3)
% Service-connected[c]			
Not service-connected	30,886 (42.1)	1,178 (36.9)	1 [Reference]
0–20	11,505 (15.7)	510 (16.0)	1.2 (1.1–1.3)
30–60	15,515 (21.1)	675 (21.2)	1.1 (0.99–1.2)
70–100	15,501 (21.1)	829 (26.0)	1.1 (1.0–1.2)
Marital status			
Never married	6,764 (9.2)	311 (9.7)	1 [Reference]
Married	42,179 (57.5)	1,803 (56.5)	0.9 (0.8–0.99)
Separated/divorced	22,110 (30.1)	987 (30.9)	0.9 (0.8–1.0)
Widowed	2,057 (2.8)	86 (2.7)	0.7 (0.5–0.9)
Unknown	297 (0.4)	5 (0.2)	NR[d]
Served in support of wars in Iraq and/or Afghanistan			
No	70,340 (95.8)	3,103 (97.2)	1 [Reference]
Yes	3,067 (4.2)	89 (2.8)	1.0 (0.8–1.3)
Cigarette smoking status			
Nonsmoker (never or former)	28,916 (39.4)	1,409 (44.1)	1 [Reference]
Current smoker	18,401 (25.1)	545 (17.1)	0.7 (0.6–0.8)
Unknown	26,090 (35.5)	1,238 (38.8)	0.9 (0.9–1.0)
Body mass index, kg/m^2			

Characteristic	Nonparticipants (n = 73,407)[a]	Participants (n = 3,192)[a]	Multivariable-Adjusted[b] Associations of Participation, OR (95% CI)
25.0–29.9	26,931 (36.7)	333 (10.4)	1 [Reference]
30.0–34.9	28,283 (38.5)	1,112 (34.8)	3.4 (3.0–3.9)
35.0–39.9	11,808 (16.1)	899 (28.2)	6.3 (5.5–7.2)
≥40.0	6,385 (8.7)	848 (26.6)	11.0 (9.6–12.7)
Mean (SD)	32.4 (5.3)	36.9 (6.6)	NA
Facility type			
Medical center	39,205 (53.4)	2,317 (72.6)	1 [Reference]
Community-based outpatient clinic (CBOC)	33,939 (46.2)	875 (27.4)	0.8 (0.7–0.8)
Unknown	263 (0.4)	0	NR[d]
Distance to medical center or CBOC, miles			
<30	37,000 (50.4)	2,100 (65.8)	1 [Reference]
≥30	36,300 (49.5)	1,089 (34.1)	0.6 (0.6–0.7)
Unknown	107 (0.1)	3 (0.1)	NR[d]
Health care and chronic illnesses			
No. of primary care visits[e]			
1 or 2	24,669 (33.6)	144 (4.5)	1 [Reference]
3 or 4	15,675 (21.4)	432 (13.5)	3.4 (2.8–4.2)
5–8	18,609 (25.4)	1,096 (34.3)	6.1 (5.1–7.4)
≥9	14,454 (19.7)	1,520 (47.6)	8.7 (7.2–10.5)
Diabetes			
No	47,520 (64.7)	1,682 (52.7)	1 [Reference]
Yes	25,887 (35.3)	1,510 (47.3)	0.9 (0.8–1.0)
Coronary artery disease			
No	61,933 (84.4)	2,567 (80.4)	1 [Reference]
Yes	11,474 (15.6)	625 (19.6)	1.0 (0.9–1.1)
Hypertension			
No	19,735 (26.9)	666 (20.9)	1 [Reference]
Yes	53,672 (73.1)	2,526 (79.1)	1.0 (0.9–1.1)
Osteoarthritis			
No	45,842 (62.5)	1,703 (53.4)	1 [Reference]
Yes	27,565 (37.6)	1,489 (46.7)	1.1 (0.99–1.2)
Dyslipidemia			
No	24,902 (33.9)	827 (25.9)	1 [Reference]
Yes	48,505 (66.1)	2,365 (74.1)	1.0 (0.95–1.1)
Sleep apnea			
No	61,487 (83.8)	2,181 (68.3)	1 [Reference]
Yes	11,920 (16.2)	1,011 (31.7)	1.3 (1.2–1.4)
No. of comorbidities[f]			

Characteristic	Nonparticipants (n = 73,407)[a]	Participants (n = 3,192)[a]	Multivariable-Adjusted[b] Associations of Participation, OR (95% CI)
0	4,894 (6.7)	144 (4.5)	1 [Reference]
1	13,686 (18.6)	355 (11.1)	1.0 (0.8–1.2)
2 or 3	39,142 (53.3)	1,521 (47.7)	1.1 (0.9–1.3)
≥4	15,685 (21.4)	1,172 (36.7)	1.1 (0.9–1.4)
Bipolar disorder			
No	69,934 (95.3)	2,926 (91.7)	1 [Reference]
Yes	3,473 (4.7)	266 (8.3)	1.2 (1.1–1.5)
Depression			
No	45,780 (62.4)	1,637 (51.3)	1 [Reference]
Yes	27,627 (37.6)	1,555 (48.7)	1.2 (1.1–1.3)
Schizophrenia			
No	71,527 (97.4)	3,065 (96.0)	1 [Reference]
Yes	1,880 (2.6)	127 (4.0)	1.2 (0.96–1.5)
Any mental health condition[g]			
No	41,892 (57.1)	1,472 (46.1)	1 [Reference]
Yes	31,515 (42.9)	1,720 (53.9)	1.5 (1.4–1.6)

Abbreviations: VA, Department of Veterans Affairs; OR, odds ratio; CI, confidence interval; SD, standard deviation; NA, not applicable; NR, not reported.
[a] Values are numbers (percentage) unless otherwise indicated; percentages may not sum to 100 because of rounding.
[b] Adjusted for all other variables in the table. Standard errors used to calculate 95% CIs are based on a sandwich estimator that takes into account the clustering of individuals within facilities.
[c] "Service connected" means that the disability was a result of disease or injury incurred or aggravated during active military service. Ratings are graduated according to the degree of the veteran's disability on a scale of 0% to 100%, in increments of 10%. Zero percent is different than having no rating; it means that a disability exists and is related to the veteran's service, but it is not so disabling that it entitles the veteran to compensation payments.
[d] Estimates are not reported for categories with <10 participants.
[e] Primary care visits from MOVE! implementation to end of follow-up.
[f] Sum of comorbidities that indicate MOVE! eligibility, specifically, diabetes, coronary artery disease, hypertension, osteoarthritis, dyslipidemia, and sleep apnea.
[g] Entered into separate logistic regression model in place of individual mental health conditions (bipolar disorder, depression, and schizophrenia).

Table 3. Changes in Primary and Secondary Outcome Measures Among MOVE! Participants and Eligible Nonparticipants, VA Northwest Region

Return

Measure	Mean (95% CI)		*P* Value
	Nonparticipants (n = 19,487)[a]	Participants (n = 942)[a]	
Weight, lb			
Baseline	223.3 (222.7 to 223.9)	252.3 (248.9 to 255.6)	<.001
Follow-up			
6 mo	224.4 (223.8 to 225.0)	250.5 (247.2 to 253.8)	<.001
12 mo	223.6 (223.0 to 224.2)	250.6 (247.2 to 253.8)	<.001
Change			
6 mo	0 (−0.2 to 0.1)	−2.1 (−2.8 to −1.5)	<.001

Measure	Mean (95% CI)		*P* Value
	Nonparticipants (n = 19,487)[a]	Participants (n = 942)[a]	
12 mo	0.3 (0.1 to 0.4)	−1.7 (−2.5 to −0.9)	<.001
Adjusted[b] participants − nonparticipants			
6 mo		−1.3 (−2.6 to −0.02)	.048
12 mo		−0.9 (−2.0 to 0.1)	.07
Body mass index, kg/m²			
Baseline	32.2 (32.1 to 32.3)	36.8 (36.4 to 37.2)	<.001
Follow-up			
6 mo	32.4 (32.3 to 32.4)	36.5 (36.1 to 36.9)	<.001
12 mo	32.2 (32.2 to 32.3)	36.6 (36.1 to 37.0)	<.001
Change			
6 mo	0 (−0.02 to 0.02)	−0.3 (−0.4 to −0.2)	<.001
12 mo	0 (0.02 to 0.06)	−0.2 (−0.4 to −0.1)	<.001
Adjusted[b] participants − nonparticipants			
6 mo		−0.2 (−0.4 to −0.01)	.04
12 mo		−0.1 (−0.3 to 0.001)	.05

Abbreviations: VA, Department of Veterans Affairs; CI, confidence interval; BMI, body mass index.
[a] Data were available to assess 6-month change measures for 17,139 nonparticipants and 951 participants. Mean baseline weight and BMI in nonparticipants was 224.4 lb (95% CI, 223.8–225.0 lb) and 32.4 kg/m² (95% CI, 32.3–32.4 kg/m²), respectively. Mean baseline weight and BMI in participants was 252.6 lb (95% CI, 249.3–255.9 lb) and 36.8 kg/m² (95% CI, 36.4–37.2 kg/m²), respectively.
[b] Multivariable adjusted analyses included the following covariates: baseline value for measure, days between baseline and follow-up measurements, age at baseline (<40, 40–54, 55–64, 65–69), sex, race (white, black, Native Hawaiian/Pacific Islander, American Indian/Alaska Native, other), marital status (never married, married, divorced/separated, widowed), facility (5 sites), service connectedness (not service-connected, 0%–20%, 30%–60%, 70%–100%), cigarette smoking status (never or former, current, unknown), BMI at baseline (continuous), medical center or community-based outpatient clinic (CBOC), distance to medical center or CBOC (<30 miles, ≥30 miles), number of primary care visits during follow-up (1 or 2, 3 or 4, 5–8, ≥9), hypertension, osteoarthritis, dyslipidemia, sleep apnea, and mental illness. Standard errors were adjusted for clustering of participants in facilities using a clustered sandwich estimator.

Appendix

Return

Algorithms to identify measures that were implausible and/or erroneous vital sign values

For weight, height, and body mass index, we first removed biologically implausible values (weight <75 lb or >600 lb, height <49 in or >94 in, and body mass index >80 kg/m²) (1,2). Next, we applied algorithms to identify measures that were plausible but appeared to be erroneous on the basis of a review of all recorded weights and heights during the relevant time period. After reviewing records that had large standard deviations (SDs) (explained in more detail below), we used the algorithm that follows to exclude values that were likely erroneous while keeping values that were plausible. We excluded any weight measurements that met the following 2 criteria: 1) the difference between the mean weight and weight in question was greater than the SD and 2) the SD was greater than 10% of the mean. For example, 1 participant's weight in pounds was recorded as 300 and 160 lb, both measured on December 7, 2005, 310 lb measured on June 12, 2006, 276 lb measured on August 8, 2006, 291 lb measured on August 15, 2006, and 291 lb measured on September 13, 2007, resulting in mean (SD) of 271.3 (55.7) lb. The weight of 160 lb recorded on December 7, 2005, was considered erroneous and dropped because the difference between the index weight and mean weight was greater than the SD (271 − 160 = 113.3 lb) and the SD was greater than 10% of the mean of all weights ([55.7/271.3] × 100 = 20.5%). Using a similar method, we considered a participant's height measurement to be erroneous if 1) the difference between the mean height and height in question was greater than the SD and 2) the SD was greater than 2.5% of the average height. The most deviant height was dropped, and the same algorithm was rerun to identify any additional implausible height values. Participants with at least half of remaining heights flagged as implausible were dropped from analyses. Only 0.2% of measured weights and 0.99% of measured heights were considered erroneous and excluded after applying these rules.

For the secondary outcomes, the following values were considered to be implausible: high-density lipoprotein (HDL) cholesterol <10 or >120 mg/dL, LDL cholesterol <30 or >300 mg/dL, systolic blood pressure <60 or >250 mm Hg, and diastolic blood pressure <40 or >140 mm Hg.

Conditions resulting in exclusion from analyses

Participants with *International Classification of Diseases, Clinical Modification, Ninth Revision* (ICD-9-CM) diagnosis codes indicating the presence of 1 or more of the following conditions were not considered eligible for a weight management program: HIV; progressive central nervous system infections; organic brain syndromes or dementias; anorexia; anterior horn cell disease (including amyotrophic lateral sclerosis); Huntington's disease; cirrhosis; dialysis; congestive heart failure; chronic obstructive pulmonary disorder; neurological disorders; septicemia; peritonitis; hepatitis with hepatic coma; transplant surgery; or residing in a nursing home, hospice, residential, or adult day health care. In addition, participants with a hospitalization within 30 days before or after their last recorded primary care visit were ineligible. We excluded participants who were pregnant in the prior year, had a cancer diagnosis combined with oncology codes indicating active treatment, or had 3 or more admissions for day hospital or intensive care management. Oncology codes indicating active treatment were 141.0–208.9x (except 140–140.9 and 173.0–173.9) plus 2 or more oncology Stop Codes (XRT 149, Onc 316, ChemoRX 330, 431).

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SPECIAL TOPIC

Predictors of Risk and Resilience for Posttraumatic Stress Disorder Among Ground Combat Marines: Methods of the Marine Resiliency Study

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PEER REVIEWED

Abstract

The Marine Resiliency Study (MRS) is a prospective study of factors predictive of posttraumatic stress disorder (PTSD) among approximately 2,600 Marines in 4 battalions deployed to Iraq or Afghanistan. We describe the MRS design and predeployment participant characteristics. Starting in 2008, our research team conducted structured clinical interviews on Marine bases and collected data 4 times: at predeployment and at 1 week, 3 months, and 6 months postdeployment. Integrated with these data are medical and career histories from the Career History Archival Medical and Personnel System (CHAMPS) database. The CHAMPS database showed that 7.4% of the Marines enrolled in MRS had at least 1 mental health diagnosis. Of enrolled Marines, approximately half (51.3%) had prior deployments. We found a moderate positive relationship between deployment history and PTSD prevalence in these baseline data.

Introduction

Chronic psychiatric illness such as posttraumatic stress disorder (PTSD) is a major public health problem among current and former military service members, especially those who have served in combat. The prevalence of PTSD among service members and veterans varies widely, but deployment to a war zone is consistently associated with an increased risk for PTSD by a factor of 1.5 to 3.5 across war eras (1). The Iraq and Afghanistan conflicts are no exception (2,3). Additionally, blast-related brain injuries, which are frequently associated with PTSD, are common (3,4). Although suicide rates among active duty personnel have risen since these conflicts started in 2003, reasons for the increase are not fully understood and are being investigated (5). PTSD and mild traumatic brain injury (TBI) appear to be risk factors for suicidal behavior (6). The number of veterans of the current conflicts seeking care at Veterans Health Administration (VHA) facilities has increased (7). Many of these veterans have met screening or diagnostic criteria for PTSD (20%–39%), often co-occurring with depression, anxiety, substance use disorders, and chronic pain (7,8). Associated long-term personal and societal costs are high.

Evidence-based therapies for PTSD have shown only modest efficacy in targeting war trauma (9). Increasingly, military resources are being invested in preventing PTSD. However, scientific advances in understanding the etiology and natural history of PTSD needed to develop effective prevention and treatments have been hampered by reliance on retrospective, cross-sectional research (10). Several prospective investigations of military cohorts have now been initiated (2,3,11). The Marine Resiliency Study (MRS) is singular among these investigations in its combined study of operational units and its biological, psychological, and social scope.

The objective of this article is to describe the research methods used in the MRS, a unique collaboration between the Marine Corps, Navy, Veterans Affairs (VA) Health Services Research and Development (HSR&D), and academia. The description of participant characteristics before deployment combined with future longitudinal data analysis may allow researchers to identify modifiable multisystem risk and resilience factors for combat-related PTSD. The potential factors

under investigation are measures of arousal, cardiovascular and physical fitness, mental health, stress reactivity, genetics, neurocognitive function, deployment stressors, and social and military support.

Methods

Study design

The MRS entails prospective longitudinal evaluations of biological, psychophysiological, psychosocial, and neurocognitive moderators and mediators of combat stress in Marines recruited from 4 infantry battalions of the 1st Marine Division stationed at Marine Corps Air-Ground Combat Center, 29 Palms, or Camp Pendleton, both in southern California. Commanders of battalions deploying at time frames acceptable to MRS were briefed on study goals, and Marines in available battalions were invited to participate. Testing began on the first of the 4 enrolling battalions in July 2008 and will continue through May 2012. The institutional review boards of the University of California San Diego, VA San Diego Research Service, and Naval Health Research Center approved the study.

The primary study hypothesis is that mental health progression and outcomes among Marines exposed to combat and operational stress, trauma, and loss will be determined by risk and resilience factors across all study domains. Data analysis and hypothesis testing will be iterative, initially testing specific hypotheses within domains, followed by integrated analysis across domains to test the primary study hypothesis. The main goal is to provide the Marine Corps with targets for future prevention interventions. A secondary goal is to enhance scientific understanding of the nature and causes of PTSD.

Data collection plan

Close collaboration with the Marine Corps and the Navy, which provides health support for the Marine Corps, enables comprehensive on-site data collection. Data sources include the following: 1) on-site assessments, described in Measures; 2) archival medical record and service data; and 3) ancillary genetic and genomic studies funded by the National Institute of Mental Health (Figure 1). The subject-specific archival data from CHAMPS are integrated with directly collected MRS data and stored in a database maintained at the VA San Diego Medical Center. When the ongoing National Institutes of Health–funded studies of genome-wide association and gene expression are completed, their results will be combined with the MRS database for analysis.

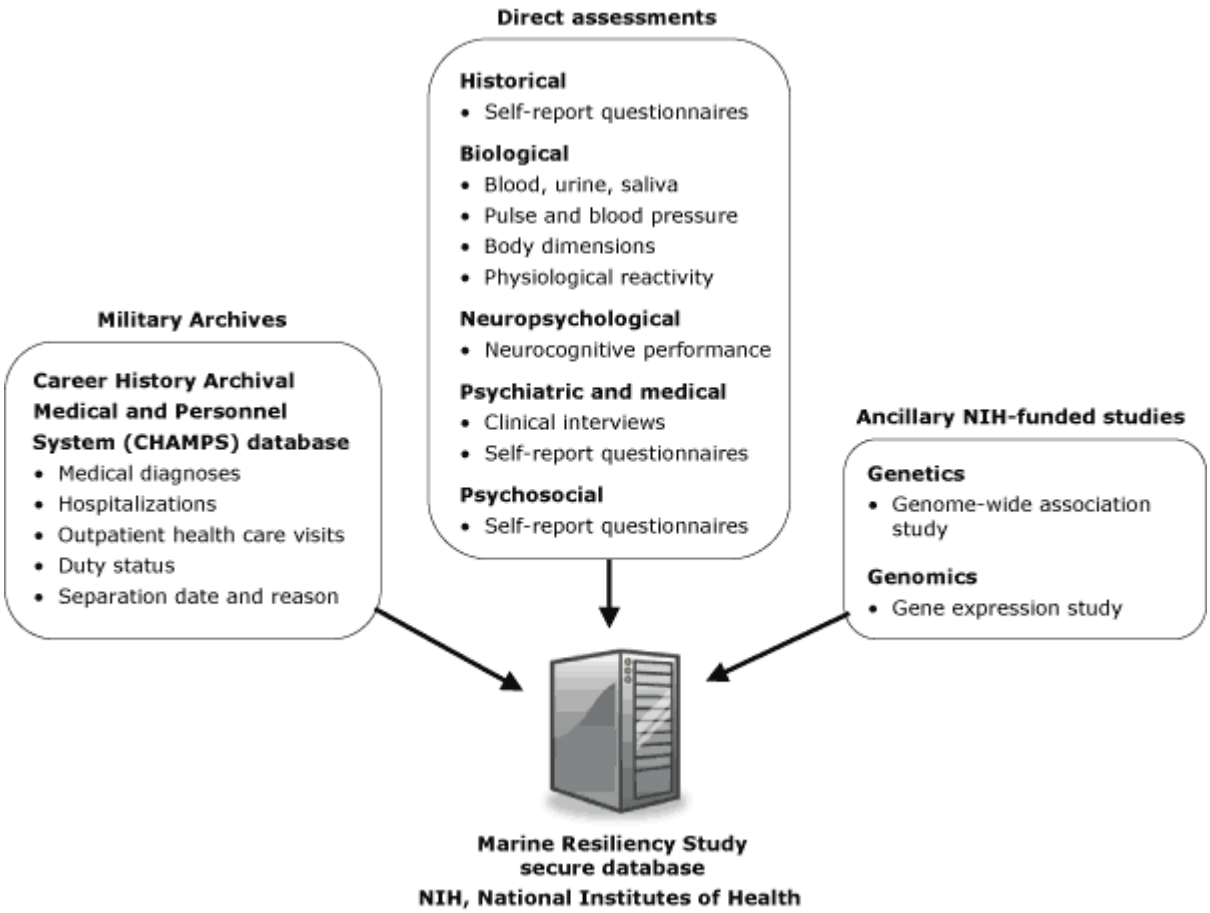

Figure 1. Data sources available to the Marine Resiliency Study. [A text description of this figure is also available.]

Study setting and participant recruitment

The MRS on-site assessment plan provides for data collection across each battalion's 14-month deployment cycle. Marines are evaluated at 4 points relative to their deployments to either Iraq or Afghanistan: T1, approximately 1 month before a 7-month war-zone deployment; T2, 1 week postdeployment; T3, 3 months postdeployment; and T4, 6 months postdeployment. Most assessments are conducted in Marine training spaces on a Marine Corps base. Some participants are assessed at the VA San Diego Medical Center or elsewhere if they have left their military units before study completion for reasons such as relocation, discharge, or injuries during deployment. Special efforts are made to gain access to ill and injured Marines. Individual informed consent is obtained before enrollment at time T1 both for direct assessment and the use of collateral data such as military health and service records. Although the study is sponsored by Marine leadership, participation at each point is voluntary.

Outcome measures

Self-report questionnaires

Participants complete self-report questionnaires (Table 1) in classrooms or other shared spaces furnished with desks or chairs. Many measures selected for use in MRS are identical to those recommended by the federal interagency working group jointly chartered by the VHA, Department of Defense, and National Institutes of Health to recommend common data elements for operational stress research and surveillance (12). Other forms, such as demographic and family history questionnaires tailored for various points, were derived ad hoc for the study. An 18-item Cohesion Scale was created by combining items from 3 validated military social support scales. In addition, we generated a 14-item Inner Conflict Scale, which assesses self-reported acts of omission or commission that may produce inner conflict because they betray deeply held beliefs, a source of psychological injury (13). Several other self-report measures were modified slightly for use in the study, including linking the widely used PTSD Checklist, Peritraumatic Dissociative Experiences Questionnaire, and Life Events Checklist to the single worst or most distressing event identified by the subject during clinical interview. A 34-item Childhood Trauma Questionnaire (CTQ) is modified from the standard 28-item report (14).

Self-report measures analyzed for this article are Your Health and Well-Being version 2 (SF-12), a measure of functional health, and the CTQ, a measure of childhood adversity (14,15). Age-adjusted norms are available for the SF-12; low SF-12 scores may indicate a risk for PTSD (16). The CTQ is a measure of pre-enlistment stress or adversity.

Clinical interviews

We interviewed each subject in a sound-dampened private office at points T1, T3, and T4, primarily to assess PTSD symptoms. No clinical interviews were conducted at T2, immediately postdeployment, to minimize subject burden. The primary outcome variable is the Clinician-Administered PTSD scale, a gold-standard structured interview (17). Clinical evaluators also assess panic disorder using a module from the Mini-International Neuropsychiatric Interview, and a history of TBI events using criteria established by the VHA and Department of Defense. TBI symptoms assessed include loss of consciousness (LOC), duration of unconsciousness, and altered mental state (AMS) (eg, confusion or dazed feeling or posttraumatic amnesia). To ensure interrater reliability of structured interviews, all interviewers were trained and certified before each battalion was enrolled, and interrater reliability was assessed on 5% of all interviews for each data collection, in real time with 2 certified raters: 1 rater to conduct the interview and the other rater to provide an observational interrater reliability co-rating.

Laboratory specimen collection

Autonomic and metabolic traits co-vary with PTSD pathophysiology; we chose stress system, immune and metabolic biomarkers and modulators, C-reactive protein, neuropeptide-Y, and chromogranin-A from plasma; cortisol, cotinine, and α-amylase from saliva; and catecholamines, epinephrine, and norepinephrine from urine to assess these traits (18). Blood, urine, and saliva are collected from each subject at T1, T3, and T4.

Body measurements

Height, weight, and waist circumference are measured at T1, T3, and T4, and body mass index is calculated.

Hemodynamics

Resting blood pressure and heart rate are measured 3 times, each separated by 3-minute rest periods using the noninvasive DynaPulse oscillometric brachial cuff (PulseMetric, Vista, California), which enables calculation of the hemodynamic parameters of cardiac output, vascular resistance, and vascular compliance (19,20).

Physiological reactivity

Modulation of acoustic startle reactivity and heart rate are measured with a battery of 3 tests. Before testing, each participant is screened for hearing impairment and fitted with headphones while seated in a comfortable chair facing a computer monitor. After electrode placement and verification, the participant undergoes the following startle tests: 1) assessment of startle threshold using acoustic tones, 2) test of modulation of acoustic startle response while viewing

emotional images or when anticipating image presentation, and 3) test for pre-pulse inhibition and startle habituation (21). Continuous heart rate is recorded throughout testing.

Neuropsychological performance

We used a laptop computer running Automated Neuropsychological Assessment Metrics to test each participant's performance on 2 neurocognitive tasks shown in previous work to be sensitive to deployment (22) and of theoretical relevance to stress: the Continuous Performance Test, a measure of sustained attentional vigilance, and Simple Reaction Time throughput, a measure of reaction time efficiency.

Military archives

Participants' authorization through the Health Insurance Portability and Accountability Act of 1996 allows access to their medical and career history data from the CHAMPS database. Information includes demographic data, medical diagnoses, clinic visits, hospitalizations, duty status, and separation date and reason. For this report, *International Classification of Diseases, Clinical Modification* (ICD-9-CM) mental disorder diagnoses assessed during hospitalizations and ambulatory care were extracted for each subject for the time between enlistment and the participating battalion's deployment date. For each participant, only the first diagnostic code was used for analysis.

Study setting and participant recruitment

Subjects were recruited from First Marine Division infantry battalions preparing to deploy from bases in southern California to either Iraq (battalions 1 and 2, 2008) or Afghanistan (battalions 3 and 4, 2009–2010). All active duty members of these operational units were eligible. There were no exclusion criteria.

Participation was offered to 2,978 battalion members, both Marines and accompanying sailors (primarily corpsmen) (Figure 2). Of these battalion members, 2,610 (87.6%) consented to participate and 368 (12.4%) declined. The final battalion is scheduled to complete remaining assessments by May 2012. Dropout rates were highest immediately after deployment (T2) and at the final, 6-month postdeployment data collection (T4). These are the points at which the greatest flux occurred in unit composition. As of January 2012, 20 enrolled participants have been killed in action or died of combat wounds.

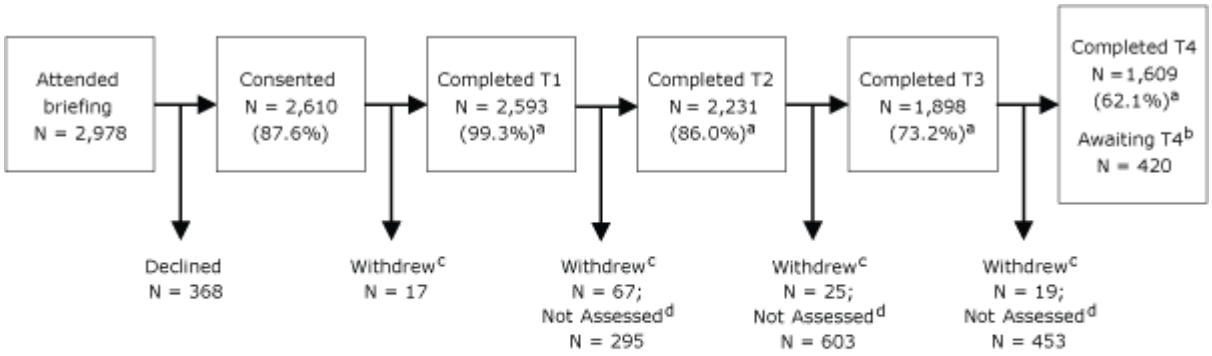

Figure 2. Subject recruitment and retention for the Marine Resiliency Study (N = 2,610) through September 2011. [A text description of this figure is also available.]

Statistical methods

Analyses were performed in SPSS version 19 (SPSS, Inc, Chicago, Illinois) and included Pearson χ^2 tests and analysis of variance for between-battalion comparisons and phi (φ) and partial eta squared (ηp^2), respectively, to estimate effect sizes. CTQ values were linearly transformed for analyses. To test the effects of prior deployments on self-reported health and wellness, we controlled for the potentially confounding effects of age. All comparisons between previously deployed and never-deployed participants were age-adjusted, and group means and standard deviations (SDs) were reported, if appropriate.

Results

We report demographic, descriptive, and self-report (SF-12, CTQ, and TBI) for all Marines who completed predeployment assessments (Table 2). For all Marines enrolled in MRS battalions at predeployment, the mean (SD)

physical health component (PHC) SF-12 score was 53.7 (6.16) and mental health component (MHC) SF-12 score was 50.2 (8.09).

Of the 1,562 (60.5%) Marines who reported prior head injury, 56.9% incurred at least 1 head injury with combined LOC and AMS symptoms. Small but significant variations in rates of TBI were found in LOC and AMS with deployment history; 54.1% of previously deployed Marines self-reported TBI with LOC and AMS compared with 60.4% of never-deployed Marines. Duration of unconsciousness did not vary significantly with deployment history.

Approximately half (51.3%) of Marines had at least 1 prior deployment at the time of enrollment in MRS. Previously deployed Marines accounted for 46.1% to 55.3% of each battalion; percentage differences were significant but small.

Mean (SD) PHC scores were slightly lower for previously deployed (53.27 [6.13]) compared with never-deployed Marines (54.17 [6.10]) ($N = 2,514$; $F1 = 13.92$; $P < .001$; $\eta p^2 = .01$). However, we found no deployment-related differences in age-adjusted MHC scores.

ICD-9-CM mental disorder diagnoses retrieved from the CHAMPS database showed that 193 (7.4%) of the 2,593 enrolled Marines had either 1 diagnosis (3.70%) or multiple (3.74%) diagnoses (Table 3). After controlling for time spent in the military before deployment, there were no significant differences in the number of mental health diagnoses per subject between previously deployed and never-deployed Marines. We did, however, find moderately significant relationships between deployment history and rates of diagnosed PTSD and diagnosed suicidal ideation. Of the 193 Marines with at least 1 ICD-9-CM diagnosis, 133 (68.9%) were previously deployed and 60 (31.1%) were never deployed. Approximately 19.6% of previously deployed Marines with an ICD-9-CM diagnosis had PTSD, compared with only 1.7% of never-deployed Marines. Conversely, only 6.0% of previously deployed Marines with an ICD-9 diagnosis were seen for suicidal ideation, compared with 21.7% of never-deployed Marines.

Discussion

MRS Marines are exclusively male and, compared with all enlisted Marines from 2008 through 2010 (Navy and Marine Corps Public Health Center data), are younger, more often unmarried, and of lower rank, similar to the demographics of war-deploying battalions (23).

As expected, scores on the SF-12 measure of functional health at predeployment are similar to population norms. Recently published studies provide evidence that low SF-12 scores and predeployment mental health diagnoses can serve as markers of vulnerability (16,24). Larson et al (24) reported that 23% of Marines seen by an in-theater mental health provider had a prior ICD-9-CM mental health diagnosis; for service members with a prior diagnosis, the highest rates of rediagnosis were for attention deficit disorder (57%) and PTSD (55%). It is therefore conceivable that MRS participants would be more likely to need in-theater treatment. The broad scope and prospective design of MRS should enable us to test this assumption and to further incorporate additional psychosocial and biological measures to better understand factors predictive of relapse and resilience.

Certain features of the enrolled sample limit its generalizability. All participants are male members of either Marine Corps or Navy (primarily health care personnel attached to Marine units), so women, civilians, and members of other services are not represented. Also, few members of the reserves and no members of the National Guard are enrolled. On the other hand, because MRS cohorts are enrolled from among Marine Corps ground combat units preparing to deploy, our results should prove generalizable to the Marine Corps, whose exposure to potentially traumatic war zone events is second only to that of the Army, as indexed by cumulative casualty rates (25). The description of participant characteristics before deployment combined with future longitudinal data analysis may allow researchers to identify modifiable multisystem risk and resilience factors for combat-related PTSD.

Acknowledgments

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Tables

Table 1. Measures Included in Self-Report Questionnaire Packets at 4 Data Collection Points for Participants in the Marine Resiliency Study

Return

Category	Measure	T1	T2	T3	T4
Personal history	Demographics[a]	X	X	X	X
	Deployment history[a]	X	X	—	—
	Family history[a]	X	—	—	—
	Child Trauma Questionnaire (CTQ)	X	—	—	—
	Life Events Checklist (LEC)	X	X	X	—
	Caffeine use[a]	X	X	X	X
	Tobacco use[a]	X	X	X	X
Personality, coping, and cognition	Connor-Davidson Resilience Scale (CD-RISC)[b]	X	X	X	X
	Response to Stressful Experiences Scale (RSES)	X	X	X	X
	Brief COPE[b]	X	X	X	X
	Positive and Negative Affect Schedule (PANAS)[b]	X	X	X	X
	Dissociative Experiences Scale (DES)[b]	X	—	—	X
	Janoff-Bulman World Assumptions Scale (WAS)[b,c]	X	X	X	—
Psychiatric symptoms	PTSD Checklist (PCL)[c]	X	X	X	X
	Peritraumatic Dissociative Experiences Questionnaire (PDEQ)[b]	X	X	X	X
	Beck Depression Inventory, Revised (BDI-II)[b]	X	X	X	X
	Beck Anxiety Inventory (BAI)[b]	X	X	X	X

Category	Measure	T1	T2	T3	T4
Health and well-being	Alcohol Use Disorders Identification Test (AUDIT)[b,c]	X	X	X	X
	Drug Abuse Screening Test (DAST)[b,c]	X	X	X	X
	Short-Form Health Survey, 12-item version (SF-12)	X	X	X	X
	World Health Organization Disability Assessment Schedule (WHO-DAS)	X	X	X	X
Social support	DRRI Deployment Social Support[b]	X	X	X	X
	DRRI Predeployment Social Support[b]	X	X	X	X
	Cohesion Scale[a]	X	X	X	X
	Interpersonal Support Evaluation List (ISEL)[c]	X	X	X	X
Deployment stressors	DRRI Combat Experiences[b]	—	X	—	X
	DRRI Perceived Threat[b]	—	X	—	—
	DRRI Aftermath of Battle[b]	—	X	—	—
	DRRI Difficult Living and Working Environments[b]	—	X	—	—
	DRRI Concerns About Life and Family Disruptions[b]	—	X	—	—
	Inner Conflict Scale (ICS)[a]	—	X	X	—
Health care	Health care utilization[a]	—	X	X	X

Abbreviations and symbols: X, included in packet; —, not included in packet; T1, 1 month before 7-month deployment; T2, 1 week postdeployment; T3, 3 months postdeployment; T4, 6 months postdeployment; PTSD, posttraumatic stress disorder; DRRI, Deployment Risk and Resilience Inventory.
[a] Created ad hoc for the study and slightly modified between time points to reflect changes.
[b] For references, see report of federal interagency operational stress common data elements working group (12).
[c] Slightly modified for the study (see text).

Table 2. Baseline Characteristics of Participants in the Marine Resiliency Study [a]

Return

Characteristic	Battalion 1 n = 315	Battalion 2 n = 721	Battalion 3 n = 671	Battalion 4 n = 886	Total n = 2,593
Age, y[b]					
Mean (SD)	21.4 (3.1)	21.9 (3.4)	22.7 (3.5)	22.7 (3.7)	22.3 (3.5)
Range	18–42	18–47	18–47	18–43	18–47
Marital status, %[b]					
Not married	71.7	68.0	57.7	54.4	61.1
Married	26.3	28.6	38.7	40.4	35.0
Divorced/separated	1.9	3.2	3.6	4.2	3.5
Deployments, %[b]					
Never deployed	46.0	44.5	53.9	48.1	48.4
Previously deployed	54.0	55.3	46.1	51.1	51.3
Rank, %[b]					
E1-E3	75.9	75.5	68.9	58.5	68.0
E4-E9	21.0	22.6	27.4	38.4	29.0
O1-O9	3.2	1.7	3.1	2.3	2.4

Characteristic	Battalion 1 n = 315	Battalion 2 n = 721	Battalion 3 n = 671	Battalion 4 n = 886	Total n = 2,593
Race, %					
European American	84.4	87.4	78.5	81.6	82.8
African American	2.9	3.7	5.5	5.5	4.7
Asian	3.5	2.5	2.4	2.8	2.7
American Indian	0.6	1.4	1.6	1.5	1.4
Pacific Islander	1.6	1.2	0.9	2.0	1.5
Mixed/other	7.0	3.5	5.8	5.1	5.1
Ethnicity, %					
Not Hispanic	77.8	79.9	73.8	74.7	76.3
Hispanic/Latino	22.2	19.7	25.2	24.7	23.1
Childhood trauma					
Total score, mean (SD)	40.8 (13.1)	39.4 (13.4)	38.5 (12.5)	42.0 (14.9)	40.3 (13.7)
Total score, range	25–95.5	25–106.5	25–105.3	25–103.3	25–106.5
Head injury, %	67.9	65.7	58.4	55.1	60.5
TBI with LOC and AMS[c]	54.2	60.5	54.7	56.4	56.9
Duration of LOC, %[d]					
≤15 min	63.8	62.6	60.3	59.0	61.1
16–30 min	12.9	14.0	18.7	16.5	15.7
≥30 min	10.3	14.0	11.2	10.6	11.8
Unknown	12.9	9.4	9.8	13.9	11.4
SF-12 – NEMC mean, (SD)					
Physical	54.9 (5.7)	53.5 (6.3)	54.0 (6.0)	53.3 (6.2)	53.7 (6.2)
Mental	49.0 (8.4)	49.3 (8.3)	50.7 (7.6)	50.7 (7.8)	50.2 (8.1)

Abbreviations: SD, standard deviation; E1-E9, enlisted; O1-O9, officer; TBI, traumatic brain injury; LOC, loss of consciousness; AMS, altered mental state; SF-12, Health and Well-Being Questionnaire; NEMC, New England Medical Center.
[a] Percentages based on predeployment N (visit 1) and may not sum to 100% due to missing data.
[b] Very small but significant differences in age (F3 = 16.01; $P < .001$, ηp2 = .02), marital status ($\chi^2_3 = 48.20$; $P < .001$; φ = .14), rank ($\chi^2_6 = 69.17$; $P < .001$; φ = .16), and percentage of previously deployment Marines (N = 2,585; $\chi^2_3 = 1.17$; $P < .005$; φ = .07) were detected between cohorts.
[c] Percentages based on number of Marines who reported TBI at visit 1. Small but significant variations in rates of TBI were found in LOC and AMS with deployment history (N = 1,560; $\chi^2_2 = 6.12$; $P = .013$; φ = .06).
[d] Percentages based on number of Marines who reported TBI with LOC and AMS at visit 1.

Table 3. Mental Health Diagnoses of Marines in the Marine Resiliency Study at Predeployment (T1) Assessment[a]

Return

Diagnosis	Battalion 1 n (%) (n = 315)	Battalion 2 n (%) (n = 721)	Battalion 3 n (%) (n = 671)	Battalion 4 n (%) (n = 886)	Total n (%) (N = 2,593)
Substance-related disorders					
Alcohol	4 (1.27)	45 (6.24)	28 (4.17)	39 (4.40)	116 (4.47)
Drug	1 (0.32)	11 (1.53)	6 (0.89)	0	18 (0.69)

Diagnosis	Battalion 1 n (%) (n = 315)	Battalion 2 n (%) (n = 721)	Battalion 3 n (%) (n = 671)	Battalion 4 n (%) (n = 886)	Total n (%) (N = 2,593)
Adjustment disorders	6 (1.90)	26 (3.61)	27 (4.02)	21 (2.37)	80 (3.09)
Mood disorders					
Major depression	2 (0.63)	7 (0.97)	4 (0.60)	4 (0.45)	17 (0.66)
Bipolar disorder	0	1 (0.14)	0	0	1 (0.04)
Dysthymia	0	5 (0.69)	3 (0.45)	4 (0.45)	12 (0.46)
Depression, not otherwise specified	2 (0.63)	11 (1.53)	7 (1.04)	8 (0.90)	28 (1.08)
Mood disorder, not otherwise specified	2 (0.63)	0	0	0	2 (0.08)
Personality disorders	0	8 (1.11)	5 (0.75)	7 (0.79)	20 (0.77)
Psychotic disorders					
Schizophrenia	0	0	0	0	0
Brief psychotic disorder	0	0	0	0	0
Psychosis, not otherwise specified	0	1 (0.14)	0	0	1 (0.04)
Anxiety disorders					
Panic disorder	1 (0.32)	5 (0.69)	1 (0.15)	3 (0.34)	10 (0.39)
Generalized anxiety disorder	1 (0.32)	0	1 (0.15)	1 (0.11)	3 (0.12)
Obsessive-compulsive disorder	0	0	0	0	0
Phobias	0	1 (0.14)	0	0	1 (0.04)
Acute stress	0	3 (0.42)	1 (0.15)	1 (0.11)	5 (0.19)
Posttraumatic stress disorder[b]	2 (0.63)	10 (1.39)	8 (1.19)	8 (0.90)	28 (1.08)
Anxiety, not otherwise specified	2 (0.63)	9 (1.25)	8 (1.19)	9 (1.02)	28 (1.08)
Somatoform/dissociative/factitious disorders					
Dissociative disorder	0	0	0	0	0
Factitious disorder	0	0	0	0	0
Conversion disorder	0	1 (0.14)	0	1 (0.11)	2 (0.08)
Somatoform disorders	0	0	0	0	0
Suicidal ideation					
Ideation[c]	0	4 (0.55)	5 (0.75)	4 (0.45)	13 (0.50)
Ideation and attempt	1 (0.32)	4 (0.55)	2 (0.30)	1 (0.11)	8 (0.31)
Other mental disorders					
Organic conditions	0	0	1 (0.15)	0	1 (0.04)
Eating disorder	0	0	0	0	0
Unspecified mental disorder	1 (0.32)	0	0	0	1 (0.04)
Psychological factors, physical condition	0	1 (0.14)	2 (0.30)	0	3 (0.12)
Sleep disorder	0	2 (0.28)	7 (1.04)	5 (0.56)	14 (0.54)
All other	2 (0.63)	13 (1.8)	11 (1.64)	8 (0.90)	34 (1.31)

[a] Table reflects data derived from the Career History Archival Medial and Personnel System. Percentages based on the total N enrolled.
[b] Rates of PTSD diagnosis were significantly influenced by deployment history (N = 193; $\chi^2_1 = 10.99$; $P < .001$; $\varphi = .24$).
[c] Rates of diagnosed suicidal ideation were significantly influenced by deployment history (N = 193; $\chi^2_1 = 10.45$; $P = .001$; $\varphi = -.23$).

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PREVENTING CHRONIC DISEASE
PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

ORIGINAL RESEARCH

Participant Evaluation of a Telephone-Based Osteoarthritis Self-Management Program, 2006-2009

Nina R. Sperber, PhD; Hayden B. Bosworth, PhD; Cynthia J. Coffman, PhD; Karen A. Juntilla, MEd; Jennifer H. Lindquist, MStat; Eugene Z. Oddone, MD, MHSc; Tessa A. Walker, MPH; Morris Weinberger, PhD; Kelli D. Allen, PhD

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PEER REVIEWED

Abstract

Introduction

Self-management support interventions can help improve osteoarthritis outcomes but are underused. Little is known about how participants evaluate the helpfulness of these programs. We describe participants' evaluations of a telephone-based, osteoarthritis self-management support intervention that yielded improved outcomes in a clinical trial.

Methods

Participants were 140 people in the intervention arm of the trial who completed an end-of-trial survey. We used mixed methods to describe participants' perceived helpfulness of the program and its components. We compared ratings of helpfulness according to participant characteristics and analyzed themes from open-ended responses with a constant comparison approach. We calculated Pearson correlation coefficients between perceived helpfulness and changes in pain, function, affect, and self-efficacy.

Results

The average rating of overall helpfulness on a scale from 1 to 10 was 7.6 (standard deviation, 2.3), and more than 80% of participants agreed that each component (phone calls, educational material, setting goals and action plans) was helpful. Participants had better perceived helpfulness ratings than their counterparts if they were nonwhite, had limited health literacy, had no college education, had perceived inadequate income, were older, had a spouse or were living together in a committed relationship, and had greater symptom duration and less pain. Ratings of helpfulness increased with greater improvement in outcomes. Participants frequently mentioned the health educator's calls as being helpful for staying on task with self-management behaviors.

Conclusion

Participants viewed this intervention and each of its components as helpful for improving osteoarthritis symptoms. In addition to the improvements in objective outcomes seen in the clinical trial, these results provide further support for the dissemination of self-management support interventions.

Introduction

Self-management is an essential but underused tool for addressing arthritis, which is expected to affect 67 million American adults (25% of the projected US adult population) by 2030 (1,2). Self-management support interventions help people work toward meaningful goals regarding the medical, behavioral, and emotional aspects of their disease (3). Arthritis self-management programs can help improve pain, function, and other outcomes of patients with osteoarthritis, the most common arthritic condition; however, little is known about how patients perceive the helpfulness of these programs (4). Eliciting patients' experiences can help determine if there is concordance between outcomes that are clinically and personally important; this information can enhance evidence-based interventions so that they are well-matched to patients' needs (4-6). Our objective was to describe participant evaluations of a

telephone-based self-management support intervention for people with osteoarthritis that yielded modest improvements in pain and some aspects of physical function in a clinical trial (7).

Methods

Overview

This study is a secondary analysis from a 12-month clinical trial of an osteoarthritis self-management support intervention conducted at the Durham Veterans Affairs Medical Center (VAMC) (7,8) between 2006 and 2009. The secondary analysis was restricted to intervention-arm participants who completed the end-of-trial evaluation survey (140 of 172 participants, 81% participation). We describe their ratings of the helpfulness of the program (collected at the end of the trial), comparisons according to participants' characteristics, and relationship of ratings with change in objective outcomes.

Participants and procedure

Inclusion criteria for the clinical trial were enrollment in primary care at the VAMC; a physician diagnosis of hip or knee osteoarthritis; and persistent, current joint symptoms. Exclusion criteria were having psychoses, dementia, other health conditions that would likely prevent participation in the study, or other rheumatological conditions; being on a waiting list for arthroplasty; and participation in another osteoarthritis-related or lifestyle intervention study. Each participant received written and audio versions of osteoarthritis self-management educational materials, consisting of 10 modules: 1) the basics of osteoarthritis and self management, 2) exercise, 3) healthy eating and weight management, 4) medications, 5) joint injections and surgery, 6) talking with your doctor, 7) joint care, 8) complementary and alternative therapies, 9) stress management, and 10) sleep. Participants received monthly phone calls from a health educator to review key points from the modules, develop weekly self-management goals and action plans, and engage in problem solving. Participants chose the order of topics after covering the basic information module. This study was reviewed and approved by the institutional review board of the VAMC.

Measures

Evaluation survey

The survey was part of the end-of-trial follow-up assessment for participants in the intervention arm of the clinical trial and was administered in English either in-person (n = 112) or over the telephone (n = 28). Participants received $10 for completing follow-up assessments (7). Perceived helpfulness of the program was assessed by asking participants to rate on a scale from 1 ("not at all helpful") to 10 ("very helpful"). Participants were also asked whether specific components (health educator's calls, written or audio educational materials, and goal setting and developing action plans) helped them improve their osteoarthritis symptoms. These items were measured using a 5-point Likert scale (1 = strongly agree to 5 = strongly disagree). Likelihood of participation was assessed by the question, "If the VA offered an arthritis self-management course like this one at no cost to you, would you participate?" Possible responses were yes, no, or maybe. Participants were then asked, "If the VA offered an arthritis self-management course like this one for a fee, would you pay? How much would you pay to participate?" Possible responses were 0/would not participate for a fee, $5 to $19, $20 to $29, $30 to $39, and $40 or more. Participants were also asked an open-ended question: "What part(s) of the arthritis self-management program were most helpful to you?"

Participant characteristics

We assessed the following characteristics at baseline: age (≤54 y, 55-64 y, ≥65 y); race (white, nonwhite); education (at least some college, no college); health literacy, assessed using the Rapid Estimate of Adult Literacy in Medicine (REALM) (high school, eighth grade and below) (9); self-reported perceived inadequate income (assessed with agreement or disagreement with the statements, "You have money to pay the bills, but only because you have to cut back on things" and "You are having difficulty paying the bills, no matter what you do"); marital status (married or living together in a committed relationship or not); self-reported years experiencing arthritis symptoms (quartiles: 1-6, 7-13, 14-20, 21-64); and self-reported general health (excellent, very good, or good vs fair or poor).

Calls completed

We also examined the number of completed monthly calls and dichotomized responses as 1 to 8 or 9 to 12. (New information was delivered for the first 9 calls, and remaining calls were reserved for review or participant questions; therefore, participants who completed at least 9 calls received all intervention content.)

Osteoarthritis outcomes

Outcomes were scores from pain, mobility, and affect subscales of the Arthritis Impact Measurement Scales (AIMS2) (10); a pain visual analogue scale (VAS) (11); and the Arthritis Self-Efficacy Scale (12), which were collected at baseline and the end of the trial. The AIMS2 pain subscale consists of 5 items assessing typical pain, pain severity, and pain

during specific times of the day. The AIMS2 mobility subscale consists of 5 items that ask about one's ability to get around outside of the home. The AIMS2 affect subscale consists of 10 items that address mood and tension. All items on these subscales are measured on a 5-point Likert scale ("all days" to "no days"); scores range from 0 to 10, and higher scores indicate worse outcomes. The pain VAS is a 10-cm line on which participants mark their average pain during the past 2 weeks, using anchors of "no pain" and "pain as bad as it can be." The Arthritis Self-Efficacy Scale measures how certain patients are that they can perform 8 activities or tasks related to arthritis. Items are scored on a Likert scale (1 = very uncertain to 10 = very certain); scores range from 1 to10, and higher scores indicate better self-efficacy.

Data analysis

We used a quantitatively driven mixed-method design in which we separately analyzed open-ended responses to complement quantitative findings (13). We created contingency tables for each closed-ended question about program helpfulness to describe responses for the total sample and by participant characteristics, baseline pain VAS score (dichotomized: ≤5 = low pain, >5 = high pain [14,15]), and completed calls. For all closed-ended questions, we combined the *strongly agree* and *agree* response categories (vs *neither agree nor disagree, don't know*, *disagree,* and *strongly disagree*). We calculated Pearson correlation coefficients to examine associations between perceived helpfulness of the program and change in each osteoarthritis outcome from baseline to follow-up. One researcher coded qualitative responses with a priori (calls, educational materials, goal setting) and emergent codes (16) and continuously compared the codes to arrive at conceptually distinct categories (17). Because there is no established definition of a clinically meaningful difference in perceptions of helpfulness and value, we commented on differences close to 0.5 points or more for overall helpfulness rating and at least 5% across categories for the categorical variables. We used SAS version 9.2 (SAS Institute, Inc, Cary, North Carolina) and ATLAS.ti version 6.1 (ATLAS.ti Scientific Software Development GmbH, Berlin, Germany) software.

Results

The mean age of this sample was 60 years (Table 1). Most participants were male, and approximately half were white. On a scale from 1 to 10, participants' mean rating of the program's helpfulness was 7.6 (Table 2). More than 80% of participants overall strongly agreed or agreed that each component helped improve their osteoarthritis symptoms. Eighty-five percent said they would participate in this program if the VA offered it to them at no cost. When asked about paying to participate, 36% said that they would not participate for a fee, 34% said that they would pay $1 to $29, and 30% said that they would be willing to pay $30 or more.

Of the 140 participants who responded to the survey, 31 (22%) completed 1 to 8 calls and 109 (78%) completed 9 to 12 calls (Table 3). Mean ratings of perceived overall program helpfulness by participant characteristics ranged from 7.0 to 8.1. The rating of overall helpfulness increased with age. Participants who were nonwhite, had no college education, had a health literacy level of eighth grade or below, had perceived inadequate income, reported less pain, and were married or living together in a committed relationship reported higher mean levels of perceived helpfulness than their counterparts. Participants with the longest self-reported duration of osteoarthritis symptoms (21-64 y) had the highest average rating of overall helpfulness. Participants who completed 9 to 12 calls rated the overall helpfulness on average as 7.8, and participants who completed 1 to 8 calls had an average score of 7.0.

More than 68% of participants across the different characteristics evaluated each of the 3 intervention components as being helpful (*agree* or *strongly agree*) (Table 3). Participants who were older, nonwhite, lacked college education, had a low health literacy level, were married or living together in a committed relationship, had greater self-reported duration of osteoarthritis symptoms, or who reported less pain were more likely than their counterparts to agree that the health educator's calls were helpful. Participants who were older, nonwhite, had a low health literacy level, were married or living together in a committed relationship, or had less pain were more likely to agree that the educational materials were helpful. Participants who had the longest self-reported duration of osteoarthritis symptoms (14-64 y) were more likely to rate the educational materials as helpful than participants who reported a shorter duration of symptoms. Participants who were older, had a low health literacy level, did not report perceived inadequate income, were married or living together in a committed relationship, reported 1 to 20 years of osteoarthritis symptoms, had better self-reported general health, and had less pain were more likely than their counterparts to agree that setting goals and action plans were helpful. Participants who completed 9 to 12 calls rated the program components as helpful more (84%-90%) than participants who completed only 1 to 8 calls (68%-81%).

Correlations of perceived program helpfulness with changes in the pain VAS and AIMS2 subscale scores were negative (r = −0.10 to −0.17), indicating that as symptom levels got worse (higher scores at follow-up than at baseline), perceived helpfulness ratings were worse, or that as symptom levels improved (lower scores at follow-up than at baseline), perceived helpfulness ratings were better (Table 4). There was a positive correlation of perceived program helpfulness with arthritis self-efficacy (r = 0.17), indicating that perceived helpfulness ratings and self-efficacy increased (higher scores at follow-up) and decreased together.

When asked which part or parts of the program were most helpful, participants most frequently mentioned the health educator's calls (44 of 140, 31%), followed by educational materials (written and audio) (20 of 140, 14%) and goal setting (11 of 140, 8%). Participants also commonly said that it was helpful to learn about exercise (42 of 140, 30%) and healthy eating and weight management (20 of 140, 14%) for managing their osteoarthritis symptoms.

Health educator's calls

Of those who mentioned the calls as being the most helpful component of the intervention, almost half (21 of 44, 48%) said that the health educator's contact enabled them to stay on task with the educational materials and goal setting. One person said, "The monthly calls helped me stay aware of doing something rather than just trying to live with my arthritis." Several participants (8 of 44, 18%) found it encouraging to discuss their osteoarthritis with someone who understood their situation. As a participant stated, "[It was] emotionally and mentally satisfying to talk with the health educator, because I had some fears regarding my arthritis." Some (6 of 44, 14%) also said that the calls provided an educational benefit by imparting and clarifying information related to the modules.

Educational materials

Forty percent (8 of 20) of those who mentioned educational materials said that the information helped them understand more about their osteoarthritis and how to better manage it. One participant said, "The audio cassette explained things I did not realize about osteoarthritis, such as the causes, prevention, and why [and] how it affected me." Another participant said, "It gave me more knowledge about my options for arthritis. It's hard to do anything if you don't know how to do it." Some (4 of 20, 20%) described the written materials as an easy-to-read reference and said that the materials were helpful combined with calls. As a participant said, "I liked the book with the short chapters, making it easy to read and understand, and [the health educator] reinforced it when she called." Two participants specifically said the information was helpful for their pain management.

Goal setting

Of participants who said that goals were most helpful, some (5 of 11, 45%) indicated that the consistent calls helped them adhere to their goals, and several (3 of 11, 27%) said that goal setting spurred them to take an active role in managing their symptoms. One participant said, "Speaking to the educator on a monthly basis . . . gave me the incentive to go on for the next month." Another participant said, "Setting the goals . . . made me realize there are things I can do to help myself with the pain. It helped my mental ability to deal with the arthritis."

Exercise and healthy eating/weight management

Some participants who mentioned exercise (7 of 42, 17%) or healthy eating and weight management (2 of 20, 10%) said that implementing these behaviors helped with controlling their pain levels. However, 1 participant stated that "The exercise helped increase my strength, even improving the ability to stand up, but not with diminishing my pain level. I have more endurance to be able to walk a distance, but I still hurt a lot when I return to the house."

Discussion

This study is one of the first to describe how participants view the helpfulness of an osteoarthritis self-management support intervention for improving their symptoms (4). Comparing participants' evaluations with clinical trial outcomes can help indicate the extent to which personal experiences align with traditional objective outcomes. Overall, our results suggest that participants viewed the intervention as beneficial.

Perceived helpfulness varied by socioeconomic characteristics. In general, participants with lower health literacy, who lacked college education, or who had perceived inadequate income were more likely than their counterparts to find 1 or more aspects of the program helpful. This pattern suggests that people with limited resources may need more information about the nature and management of their disease (18). Although responses to open-ended questions were not examined according to participant characteristics, participants commonly expressed appreciation for the information that they received on how to improve their experience with osteoarthritis, as well as the easy-to-understand and multimodal delivery of the program. These results highlight the importance of making self-management support interventions appropriate and accessible to people with lower education and health literacy levels, particularly because these patients are at greater risk for more severe osteoarthritis symptoms (1).

We found that higher proportions of nonwhites than whites reported that the health educator's calls and educational materials were helpful. This difference could partially be explained by the higher numbers of nonwhites with limited health literacy or perceived inadequate income and fewer numbers with at least some college education in our sample, all of which were also associated with greater agreement that the overall program or individual components were helpful. Other researchers have also found that racial disparities in health status and osteoarthritis outcomes are explained by socioeconomic variables (18-20). However, other cultural, psychosocial, or clinical characteristics may have contributed to these racial differences in program helpfulness.

Participants who were married or living in a committed relationship had higher ratings of program helpfulness than participants who were not. Prior research has shown that close relationships are important for chronic disease outcomes in general (21), but to our knowledge this is the first study to examine perceptions of helpfulness of a self-management program according to relationship status. Participants living in close relationships may have had more support to carry out their goals and action plans during the intervention period.

Both older age and more years with osteoarthritis symptoms were associated with higher mean ratings of overall program helpfulness, and, in particular, perceived helpfulness of the educational materials and the health educator's calls. People who faced more age-related limitations or symptom persistence may have had a greater need for this type of program and, therefore, responded more strongly to the emotional and informational supports.

Participants who reported less pain were more likely than those who reported a high level of pain to find program components helpful. Patients with more pain may need a more intense behavioral program, greater coordination with clinical care, or additional treatments (eg, knee braces, joint injections, joint replacement) to perceive substantial changes in symptoms. However, although people may not perceive substantial benefits related to pain from these types of programs, other clinically important outcomes, including mental health, physical function, and acceptance of limitations, can be influenced (22,23).

Patient perceptions of program helpfulness were high, although changes in outcomes such as pain and function were moderate (7). These findings indicate that the intervention may have affected patients in ways that are not captured completely by traditional outcome measures. Because this program was designed to enhance osteoarthritis self-efficacy, patients' notions of helpfulness may have reflected a feeling of being more in command of their osteoarthritis, as has been previously reported (4). The intervention did result in a greater increase in self-efficacy, compared with usual care and the health education group (7). The monthly health educator's calls may be a source of this effect for many participants, as reflected in responses to open-ended questions, by providing consistent encouragement to help them stay on task with their osteoarthritis self-management goals and reinforcement to help them better grasp the informational material.

This study has limitations. Because this study was conducted at 1 VA medical center and consisted of a primarily male sample, generalizability may be limited. Additionally, patients may have inflated their subjective responses when talking to a study team member. We tried to minimize this potential source of bias by not having the health educator who delivered the intervention conduct these interviews.

These results provide support for ongoing efforts to increase dissemination of osteoarthritis self-management support interventions. These programs are viewed as being even more beneficial by some patient subgroups, including racial minorities and those with lower socioeconomic status, who are also at greater risk for worse osteoarthritis outcomes and who may benefit most from targeted osteoarthritis self-management support interventions.

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Tables

Table 1. Baseline Characteristics of Participants (n = 140) in the Veterans Affairs Medical Center Osteoarthritis Self-Management Support Intervention, Durham, North Carolina, 2006-2009

Return

Variable	Value[a]
Age, mean (SD), y	59.8 (10.3)
Male sex	126 (90)
Race	
White	75 (54)
Black/African American	62 (44)
Other	3 (2)
Body mass index, kg/m²	
≥30.0 (Obese)	82 (58.6)
25.0-29.9 (Overweight)	47 (35)
18.5-24.9 (Normal weight)	9 (6.4)
<18.5 (Underweight)	2 (1)
At least some college	94 (67)
Health literacy[b]	
High school	92 (66)
8th grade and below	45 (32)
Self-reported perceived inadequate income[c]	41 (29)
Married or living together in a committed relationship	102 (73)
Self-reported years with arthritis symptoms, y, mean (SD)	17.4 (13.2)
Excellent, very good, or good self-reported general health	98 (70)
Pain VAS baseline score,[d] mean (SD)	5.8 (2.3)
AIMS2[e] pain baseline score, mean (SD)	6.0 (2.3)
AIMS2 mobility baseline score, mean (SD)	1.7 (2.0)
AIMS2 mood baseline score, mean (SD)	2.7 (2.1)
AIMS2 tension baseline score, mean (SD)	4.9 (2.7)
Arthritis self-efficacy baseline score,[f] mean (SD)	5.6 (2.0)

Abbreviations: SD, standard deviation; VAS, Visual Analog Scale; AIMS2, Arthritis Impact Measurement Scales.
[a] Values are expressed as n (%) unless otherwise indicated.
[b] Assessed using the Rapid Estimate of Adult Literacy in Medicine (REALM).
[c] "You have money to pay the bills, but only because you have to cut back on things," or "You are having difficulty paying the bills, no matter what you do."
[d] The VAS is measured on a scale of 1 to 10, with 1 being "no pain" and 10 being "pain as bad as it can be."
[e] The potential range of the AIMS2 measures is 0-10, with lower scores indicating better health status.
[f] The potential range of arthritis self-efficacy is 0-10, with higher scores indicating better self-efficacy.

Table 2. Participant (n = 140) Evaluation Questions and Responses from the Veterans Affairs Medical Center Osteoarthritis Self-Management Support Intervention, Durham, North Carolina, 2006-2009

Return

Question	Value[a]
On a scale of 1-10, with 1 being not at all helpful and 10 being very helpful, how helpful was this program for you? (mean [SD])	7.6 (2.3)
The health educator's calls helped me improve my arthritis symptoms.[b]	113 (81)[c]
The educational material (written or audio) helped me improve my arthritis symptoms.[b]	119 (85)[c]
Setting goals and action plans helped me improve my arthritis symptoms.[b]	121 (86)[c]
If the VA offered an arthritis self-management course like this one at no cost to you, would you participate?	119 (85)[d]
If the VA offered an arthritis self-management course like this one for a fee, would you pay? How much would you pay to participate? (Expressed as $)	
0/Would not participate for a fee	51 (36)
1-4	7 (5)
5-19	21 (15)
20-29	19 (14)
30-39	3 (2)
≥40	39 (28)

Abbreviations: SD, standard deviation; VA, Veterans Affairs.
[a] Values are expressed as n (%), unless otherwise indicated.
[b] The 5-point scale ranged from 1 (strongly agree), to 3 (neither agree nor disagree), to 5 (strongly disagree).
[c] Number and percentage reflect combined "strongly agree" and "agree" categories.
[d] Number and percentage reflect participants who answered yes.

Table 3. Perceived Helpfulness of the Veterans Affairs Medical Center Osteoarthritis Self-Management Support Intervention, by Participant Characteristics, Durham, North Carolina, 2006-2009

Return

Baseline Participant Characteristic	Question				
	How helpful was this program for you?[b]		Health educator's calls helped me improve my arthritis symptoms[c,d]	Educational material (written and audio) helped me improve my arthritis symptoms[c,d]	Setting goals and action plans helped me improve my arthritis symptoms[c,d]
	N[a]	Mean (SD)	n (%)	n (%)	n (%)
Age, y					
≤54	37	7.2 (2.5)	28 (76)	29 (78)	29 (78)
55-64	68	7.6 (2.3)	57 (84)	59 (87)	62 (91)
≥65	35	8.1 (2.0)	28 (80)	31 (89)	30 (85)
Race					
White	75	7.5 (2.4)	57 (76)	61 (81)	65 (87)
Nonwhite	65	7.7 (2.1)	56 (86)	58 (89)	56 (86)
Education					
At least some college	94	7.5 (2.3)	73 (78)	81 (86)	81 (86)
No college	46	7.9 (2.1)	40 (87)	38 (83)	40 (87)
REALM					

High school	92	7.5 (2.3)	70 (76)	76 (83)	78 (85)
8th grade or below	45	8.0 (2.1)	42 (93)	40 (89)	41 (91)
Self-reported perceived inadequate income					
No	98	7.5 (2.2)	79 (81)	82 (84)	86 (88)
Yes	41	7.9 (2.3)	33 (81)	36 (88)	34 (83)
Married or living together in a committed relationship					
No	38	7.1 (2.8)	26 (68)	29 (76)	29 (76)
Yes	102	7.8 (2.0)	87 (85)	90 (88)	92 (90)
Self-reported years with arthritis symptoms					
1-6	31	7.5 (2.3)	23 (74)	26 (84)	29 (94)
7-13	34	7.4 (2.2)	26 (76)	27 (79)	28 (82)
14-20	38	7.4 (2.4)	31 (82)	33 (87)	35 (92)
21-64	37	8.1 (2.1)	33 (89)	33 (89)	29 (78)
Excellent, very good, or good self-reported general health					
Yes	98	7.7 (2.2)	78 (80)	83 (85)	86 (88)
No	42	7.5 (2.4)	35 (83)	36 (86)	35 (83)
Pain VAS score					
0-5	54	7.5 (2.2)	47 (87)	50 (93)	50 (93)
>5	86	7.7 (2.3)	66 (77)	69 (80)	71 (83)
Completed calls					
1-8	31	7.0 (2.3)	21 (68)	25 (81)	23 (74)
9-12	109	7.8 (2.2)	92 (84)	94 (86)	98 (90)

Abbreviations: REALM, Rapid Evaluation of Adult Literacy in Medicine; VAS, visual analog scale.
[a] Values for N may not sum to 140 because of missing data.
[b] Measured on a scale of 1 = not at all helpful to 10 = very helpful.
[c] Original 5-point scale ranged from 1 (strongly agree), to 3 (neither agree nor disagree), to 5 (strongly disagree).
[d] Counts and percentages reflect combined "strongly agree" and "agree" categories.

Table 4. Correlations of Change in Osteorthritis Outcomes (Follow-Up to Baseline) With Perceived Helpfulness of the Veterans Affairs Medical Center Osteoarthritis Self-Management Support Intervention, Durham, North Carolina, 2006-2009

Return

Arthritis Outcome	Mean Change (SD)	Correlation With Perceived Program Helpfulness, *r*[a]
Pain VAS score[b]	−1.04 (2.2)	−0.11
AIMS2 pain score[b]	−0.85 (2.2)	−0.15
AIMS2 mobility score[b]	−0.31 (1.6)	−0.13
AIMS2 affect score		
AIMS2 mood score[b]	−0.18 (1.7)	−0.17
AIMS2 tension score[b]	−0.30 (2.2)	−0.10
Arthritis self-efficacy score[c]	0.53 (1.9)	0.17

Abbreviations: SD, standard deviation; VAS, Visual Analog Scale; AIMS2, Arthritis Impact Measurement Scales.
[a] Assessed by the question, "On a scale of 1 to 10, with 1 being not helpful at all and 10 being very helpful, how helpful was

this program for you?"
[b] A negative correlation indicates that as symptom levels (pain, mobility, affect) got worse (higher scores at follow-up than baseline), perceived helpfulness ratings were worse, or as symptom levels improved (lower scores at follow-up), perceived helpfulness ratings were better.
[c] A positive correlation indicates that perceived helpfulness ratings and self-efficacy increased and decreased together.

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Tobacco Use Among Iraq- and Afghanistan-Era Veterans: A Qualitative Study of Barriers, Facilitators, and Treatment Preferences

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Abstract

Introduction
Military service and combat exposure are risk factors for smoking. Although evidence suggests that veterans are interested in tobacco use cessation, little is known about their reasons for quitting, treatment preferences, and perceived barriers to effective tobacco use cessation treatment. Our study objective was to elicit perspectives of Iraq- and Afghanistan-era veterans who had not yet quit smoking postdeployment to inform the development of smoking cessation services for this veteran cohort.

Methods
We conducted 3 focus groups among 20 participants in October 2006 at the Durham Veterans Affairs Medical Center to explore issues on tobacco use and smoking cessation for Iraq- and Afghanistan-era veterans who continued to smoke postdeployment. We used qualitative content analysis to identify major themes and organize data.

Results
Veterans expressed the belief that smoking was a normalized part of military life and described multiple perceived benefits of smoking. Although veterans expressed a high level of interest in quitting, they listed several behavioral, situational, and environmental triggers that derailed smoking cessation. They expressed interest in such cessation treatment features as flexible scheduling, free nicotine replacement therapy, peer support, and family inclusion in treatment.

Conclusion
Our results indicate that the newest cohort of veterans perceives smoking as endemic in military service. However, they want to quit smoking and identified several personal and environmental obstacles that make smoking cessation difficult. Our findings may inform programmatic efforts to increase successful quit attempts in this unique veteran population.

Introduction

Cigarette smoking is the single greatest cause of illness and death in the United States (1). Military service is a risk factor for smoking (2,3). US military veterans and service members smoke at significantly higher rates than the general population (2,4). Approximately 74% of veterans report a history of cigarette use, compared with 48% in the nonveteran population (3,5). Military service members who experience combat exposure are at even higher risk of initiating or resuming smoking (6). Almost 45% of US service members deployed to Iraq and Afghanistan smoke, which is double the rate of other nonmilitary Americans (7,8).

Most smokers want to quit smoking (9); however, most smokers who try to quit do so without the aid of smoking cessation treatments (9). Only 3% to 5% of smokers who try to quit unaided maintain their quit attempts a year later

(10). Increasing the number of successful quit attempts using evidence-based interventions is a public health priority to reduce the number of veterans who smoke.

Although evidence suggests that military personnel and veterans are interested in tobacco use cessation (11,12), little is known about their reasons for quitting, treatment preferences, and perceived barriers to quitting. The objective of our study was to elicit perspectives of Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) veterans who had not yet quit smoking postdeployment to inform the development of smoking cessation services at the Department of Veteran Affairs (VA).

Methods

We conducted 3 focus groups in October 2006 at the Durham VA Medical Center (VAMC) in Durham, North Carolina. The VAMC institutional review board approved this study.

Recruitment procedures

To be eligible for the study, participants needed to be current smokers, patients at the Durham VAMC, and OEF/OIF veterans. We identified potential participants through the Durham VAMC electronic medical record system by screening records for military service since September 11, 2001, and current smokers. We then selected a random sample of 199 veterans who met eligibility criteria. We mailed introductory letters that described the study to potential participants, indicating that we might call them to ask for their participation. After the mailing, we further restricted the sample to the 125 veterans living within a 2-hour drive of the Durham VAMC. We attempted to contact by telephone all 125 veterans at least once until 29 eligible veterans agreed to participate. During these recruitment calls, we confirmed eligibility as current smokers and OEF/OIF veterans, further explained study, and scheduled interested veterans for a focus group. Of the veterans we reached by telephone, we excluded 1 because of smoking status, 2 declined to participate, and 4 could not participate because of scheduling conflicts. Of the 29 veterans recruited, 9 did not attend their scheduled focus group; the final sample consisted of 20 veterans.

Focus group procedures

Each of the 3 focus groups consisted of 6 to 8 participants. Immediately before the focus groups, participants provided informed consent and completed brief surveys on tobacco use and demographics. One member of the study team moderated the groups (K.S.T.), and one member took notes (S.A.). The first focus group included study team observers (J.C.B., P.S.C.). We used a standardized moderator guide consisting of questions on major themes of interest. We audio recorded and transcribed all focus groups. Each group lasted approximately 90 minutes, including time for survey completion. Participants received $50 for focus group participation.

Measures

The focus group interview guide (Appendix) asked about reasons for using tobacco, solicited views on motivations, barriers, and facilitators to smoking cessation, and garnered ideas to improve smoking cessation services. In addition, we collected information on demographic characteristics (age, race, and sex), former military service status (Active Duty, National Guard, or Reserve), and smoking history, including number of pack-years smoked and level of nicotine dependence. To measure nicotine dependence, we used the 6-item Fagerström Test for Nicotine Dependence (FTND) (13).

Analysis

We examined focus group information by using qualitative content analysis, which allowed us to code text into “meaning units” that represent important concerns, beliefs, and experiences (14,15). To ascertain meaning units, we first identified emergent codes. Two team members (J.M.G., K.S.T.) independently and manually coded 1 transcript of a focus group discussion, applying 1 or more descriptive codes to chunks of text representing each participant’s contributions. The 2 coders compared codes, reconciled differences, and finalized a coding scheme through discussion. A team member (J.M.G.) applied the coding scheme to all of the transcripts, allowing for additional emerging codes, which were refined through discussion with 1 of the original coders (K.S.T.). Through discussion, we organized codes into larger themes and organized data into 4 major topics: reasons for tobacco use during and after deployment, reasons for wanting to quit smoking, perceived barriers to making a quit attempt and maintaining smoking cessation, and facilitators of making successful quit attempts. To illustrate major themes, we selected quotes, identified by focus group (FG1, FG2, FG3). For survey items, we calculated frequencies and means.

Results

Sample characteristics

Most participants were male, African American, and veterans of active duty (versus National Guard or Reserves) (Table). Participants reported low nicotine-dependence scores as measured by the FTND, and only 20% reported

heavy smoking (≥20 cigarettes/d).

Qualitative findings

Why military personnel and veterans use tobacco

Many veterans expressed the idea that tobacco use was a common and normalized behavior during deployment to Afghanistan and Iraq. “Everyone smoked more when you were over there” (FG2). Three major factors emerged on why military personnel used tobacco during deployment. First, many veterans said they used tobacco during deployment as a way to improve job performance and reduce boredom. They used cigarettes as a way to stay awake during long missions. Smokeless tobacco, however, was used during patrols and at night because tobacco smoke and lit cigarettes could reveal soldiers’ locations. Second, military personnel used tobacco as a way to manage stress. Veterans cited tobacco use as a widely accepted justification for taking breaks. “The only way I can pause . . . is if I go take a smoke break” (FG2). Also, smoking offered soldiers a way to escape from their situation to “take your mind off the horrible place you’re at” (FG2). Lastly, veterans said they used tobacco during deployment as a way to foster social connections. “There is a lot of camaraderie around smoking” (FG2). Designated smoking areas were a popular place to share information. “I smoked primarily as a way to maintain communication. The best way to get information and disseminate it was smoking areas” (FG1).Veterans used smoking as a reason to gather and offer silent support after the death of a fellow soldier. “We’d know one of the guys didn’t come back and we’d all sit there and smoke and nobody would say a word” (FG1).

Once soldiers returned stateside, they continued to smoke as a way to modulate negative moods (eg, anger dysregulation, irritability, stress). “If I have that stress in my life I’m gonna go spend that money to have that cigarette that’s gonna help calm me down before I go off on somebody for no reason” (FG3). Many veterans also cited difficulty coping with a postdeployment shift to civilian life as a reason for continuing to smoke. “Smoking is a comfort” (FG1). Veterans cited combat-related injuries, unstructured life outside of the military, sleep disorders, and inability to turn off the military mindset (eg, hypervigilance) as reasons for civilian-transition difficulties that triggered smoking. Lastly, like other nonveteran groups, participants cited tobacco addiction as a reason for continuing to smoke.

Why veterans want to quit smoking

Most veterans expressed desires to stop using tobacco; 5 major themes emerged. First, participants cited personal health as a major reason for wanting to quit using tobacco. As a young participant stated, “Well, I want to be able to breathe. I’m not trying to be funny, like, I want to be able to actually do the physical things I used to be able to do and not get all out of breath and red in the face cause that’s kind of embarrassing to be as young as I am and I used to be in the military and I’m all huffing and puffing for breath” (FG3). Improved personal health also extended to long-term health concerns of illnesses, such as cancer, as a major motivator to quit smoking.

Veterans cited becoming weary of being dependent upon cigarettes as a motivator for smoking cessation. “I’m tired of being chained to it [smoking]” (FG3). Another participant stated, “I think it is a disgusting habit. I don’t like waking up in the morning and feeling like I got to have a cigarette in my mouth” (FG2). Side effects of smoking, such as staining of teeth and hands, bad breath, and making one’s home dirty from cigarettes, strengthened veterans’ personal determination to quit.

Family also served as a reason for many young veterans to become committed nonsmokers. Some participants did not want their children to see them smoke or wanted to avoid their children’s exposure to secondhand smoke. Others cited personal experiences of seeing loved ones die of smoking-related illnesses and wanting to protect their loved ones from similar trauma. “My family is my biggest reason to quit. . . . I watched my grandfather die of lung cancer last year literally until he took his final breath and I will not let my children see me die that way” (FG1).

Veterans cited the cost of cigarettes and shifting social norms on smoking as strong environmental cues to become nonsmokers. “It’s getting too expensive to smoke” (FG3). Social pressure to become a nonsmoker seemed to extend to all areas of veterans’ lives stateside. “The rest of the entire world has somehow revolved around this entire antismoking ban” (FG1).

Why it is difficult for veterans to become nonsmokers

Veterans listed several situational, behavioral, and environmental triggers that made it difficult to maintain quit attempts. Some participants said they were unaccustomed to their unstructured daily lives after structured military life and, therefore, smoked to fill the time. Others said it was difficult to break the habit because smoking was linked to so many of their other life activities, such as driving, eating, and drinking alcohol. Being around friends and family who used tobacco was a commonly cited barrier to smoking cessation. Veterans also said feelings of depression, irritability, uncontrolled anger, and sleeplessness made smoking cessation difficult. Some participants said they experienced side effects from using nicotine replacement therapy (NRT) and other cessation pharmacotherapies, which prompted smoking relapse. Lastly, many veterans said another deployment derailed a quit attempt.

What would facilitate veteran efforts to quit smoking

Focus group participants offered several recommendations for improving programs to help them make a quit attempt and maintain smoking cessation. Overall, they expressed a need for a personalized approach for smoking cessation services. “A one-size-fits-all I don’t think is going to work for smoking at all” (FG2). Specifically, veterans wanted free or reduced-cost NRT and other smoking cessation pharmacotherapies and suggested offering innovative incentives to quit smoking, such as gas, grocery coupons, or cash. Participants also said they required smoking cessation services that were convenient and accessible; they cited frustrations with smoking cessation classes offered only during regular working hours and with long waits for class enrollment. They expressed an interest in smoking cessation telephone counseling but found quitlines to be impersonal. As an alternative, they suggested personalized telephone counseling, with the option to supplement calls with in-person counseling sessions. Some veterans expressed interest in a smoking cessation peer-support program that pairs them with successful veteran ex-smokers. Lastly, participants expressed interest in providing family or household members with access to treatment.

Discussion

Tobacco use has been a part of military culture since World War I, when cigarettes became widely available; service members were issued cigarettes with their rations to help them escape the tedium of war, boost morale, and offer pleasure, comfort, and currency (16). Our results show that smoking is still perceived as endemic in military service by the newest cohort of veterans. Moreover, we found that OEF/OIF veterans felt smoking was an encouraged and normalized part of life during deployment. Our results are consistent with previous findings among active-duty service members. Deployed troops have higher rates of smoking initiation and smoking relapse compared with nondeployed troops (6).

Prior research shows that smoking is a way to manage stress, boredom, anxiety, and sleep deprivation among active-duty military personnel (17,18). Our results extend this research. Veterans described additional perceived benefits of smoking during their deployment, including creating a sense of camaraderie, facilitating communication outside one’s work area, being able to take approved work breaks to smoke, and improving job performance. Instead of smoking, military service members should be offered access to healthy activities that foster a sense of troop cohesion while alleviating stress and boredom. To counter perceptions that tobacco use improves job performance, efforts should be made to increase soldiers’ awareness of the association between smoking and risk of injury during physical training (19,20) and reinforce their beliefs that smokers present a risk to other service members during deployment because of reduced levels of readiness caused by withdrawal symptoms and lit cigarettes revealing locations (18).

Our findings suggest that veterans continue to use tobacco to modulate depressed mood, anxiety, and boredom after returning home. Feelings of stress related to interpersonal relationships (eg, family, community) are also prevalent among returning combat veterans (21,22). Smokers in our study reported using cigarette breaks as a way to deal with anger, by stepping away from escalating situations with others. When asked why quitting smoking was so difficult for them, many veterans listed symptoms consistent with depressive disorders and posttraumatic stress disorder (PTSD) (eg, irritability, uncontrolled anger, sleeplessness). Our findings align with other research; 37% of all OEF/OIF veterans seen in VA health care facilities received mental health diagnoses (23). People with mental health issues are more likely to smoke and may experience more difficulty when trying to quit (24,25). For example, people with PTSD are more likely to be smokers and smoke more heavily than smokers without PTSD (26). The VA successfully integrated tobacco use cessation treatment into PTSD mental health services (27). Further efforts should be made to integrate smoking cessation treatments into other health care services accessed by veterans.

Despite the multiple challenges OEF/OIF veterans expressed, our results indicate that these veterans have a strong desire to quit using tobacco. This finding is consistent with other research; almost 70% of veteran smokers want to quit (12). Since 2002, the VA health care system has implemented an array of systemwide evidence-based policies and programs to facilitate smoking cessation efforts (4). These included such changes as increased access to smoking cessation pharmacotherapies and elimination of copayments for outpatient smoking cessation counseling; these positive changes contributed to an increase of approximately 60% in NRT and buproprion prescriptions from 2004 to 2008 (28). Moreover, virtually all VAs offer some form of a tobacco control program, and most veterans seen in the VA for care are screened for tobacco use and provided with brief cessation counseling (11,29). Although empirically based smoking cessations services are available free at the VA, many of the participants in our study reported not knowing services were available, suggesting an opportunity to improve marketing of existing VA smoking cessation services.

Our findings should be interpreted with caution. A regional cohort limits the generalizability of our findings; the results may not represent the needs and preferences of veterans living outside the southeastern US region or veterans not seeking VA care. Furthermore, OEF/OIF veterans may have unique smoking needs and preferences that may not translate to other veteran cohorts. Also, we were not able to directly assess psychiatric diagnoses in this cohort. Future studies should include full mental health history and include more geographically diverse samples.

Smoking is prevalent in military service and is a behavior that carries over into civilian life. We found that OEF/OIF veterans want to quit smoking but have multiple behavioral, situational, and environmental triggers that make smoking cessation complex. In addition, these veterans are younger overall than past cohorts of veterans seeking VA care (23,30). Thus, these veterans often have young families and are engaged in school and work. Future smoking cessation strategies for OEF/OIF veterans may need to promote themes that have not been used for previous cohorts (eg, quit for the sake of children, increase physical stamina). This younger cohort may also be more likely to use new technologies to get help. The Department of Defense website, Quit Tobacco — Make Everyone Proud (www.ucanquit2.org), provides online assistance with live chat services and individualized quit plans. The Department of Defense and the VA have partnered to extend access for this online resource to veterans enrolled for care in the VA to target the smoking cessation needs of OEF/OIF veterans. Themes from our analysis may help serve as a foundation to reach, engage, and facilitate successful quit attempts in this unique veteran population.

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Table

Table. Characteristics of Iraq- and Afghanistan-Era Veterans (N = 20) Participating in Focus Groups on Tobacco Use, Durham, North Carolina, 2006

Return

Characteristic	Value[a]
Male, n	17
Age, mean (SD), y	34.8 (9.5)
Race, n	

White	7
African American	11
Native American	1
Not reported by participant	1
Former military service status, n	
Reserve	1
National Guard	4
Active Duty	13
Not reported by participant	2
Packs-years,[b] mean (SD), n	11.9 (14.3)
Fagerström Test for Nicotine Dependence,[c] mean score (SD)	4.3 (2.2)

Abbreviation: SD, standard deviation.
[a] Mean values exclude participants with missing data (age, 1; military service status, 2; pack-years, 2).
[b] One pack-year is the equivalent of smoking 20 cigarettes per day for 1 year.
[c] Test score options ranged from 0 to 10; high level of dependence was defined as a score ≥6.

Appendix. Veteran Focus Group Moderator Guide: Tobacco Use and Cessation Among Returning Veterans (N = 20) of Operation Enduring Freedom and Operation Iraqi Freedom, Durham Veterans Affairs Medical Center, North Carolina, 2006

Return

Introduction

Hello, everyone. Thank you for taking time out of your busy schedules to talk to us today.

I am _____. We have been working with veterans to find out about their use of cigarettes and other tobacco products and their experiences with trying to quit. Also, in the room is_____ who will be writing things on the flipcharts and _____ who will be taking notes about what seem to be the most important issues that we discuss. All of us will keep the discussions confidential.

On behalf of myself and the staff at the VA, I want to express our appreciation for your service to the country. Thank you.

Purpose

Our primary purpose today is to discuss your experiences with tobacco both during deployment and after you came home. Your issues, comments, and recommendations are very important to us and we are here to learn from you. Therefore, I am going to do as little talking as possible.

I will be asking some questions, asking for more information on certain topics, and generally moderating the discussion. There are no right or wrong answers — it's your opinions and thoughts that are important to us.

Procedure

Before we get started, I would like to talk about the process.

- First, everything we talk about is confidential.
- Second, your participation is voluntary. If you don't want to participate in part of the discussion, you don't have to.
- Third, we will audiotape the discussion to make sure we get all the information you provide.
- Fourth, I am interested in hearing from everyone here. So, at times I may call on you directly to get your opinion. At other times, I may need to interrupt so that I can hear from others or to move us along to the next question.
- Because this will be audiotaped, this works best if only one person speaks at a time.

Are there any questions before we get started?

1. (Ice Breaker). First, I'd like to hear *briefly* about your deployment experiences. Can you tell me your branch and component of service (eg, Army or Marines, Reserve, National Guard, or Active Duty) and how long were you deployed?

    Probe: When did you last return from deployment?

2. Did you smoke in the military or use chewing tobacco? Please tell us a little about this including when and why you smoked or used chewing tobacco.

    Probe: Are you still smoking?

    Probe: How has your smoking changed, if at all, since you've been home?

3a. What reasons might be important enough to you to quit smoking?

    Probe: Which of the concerns we've just talked about are MOST important to you? (UNDERLINE or * on the flipchart)

3b. What messages might influence you to consider quitting? These could be communications from your doctors, friends/family, peers, media?

    Probe: Which of the messages we've just talked about are MOST important to you? (UNDERLINE or * on the flipchart)

3c. What do you think would help you make a quit attempt?

    Probe: What would help you make use of VA services for smoking cessation?

    Probe: What has helped you make quit attempts in the past?

3d. What would make smoking cessation treatment more attractive?

    Probe: What would be included in a program that would be attractive?

4. What got in the way of previous attempts to quit?

    Probe: What barriers have you encountered when trying to quit?

5. What could the VA do to help you or someone you know stop smoking or using tobacco products?

That's all the time we have. Again, I would like to thank you for your time tonight and for your service to our country.

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PREVENTING CHRONIC DISEASE
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ORIGINAL RESEARCH

Chronic Diseases in Male Veterans With Multiple Sclerosis

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PEER REVIEWED

Abstract

Introduction
Chronic disease risk may be high in people with multiple sclerosis (MS). Our objective was to identify chronic health conditions that may disproportionately affect male veterans with MS.

Methods
We collected primary survey data for male veterans with MS (n = 1,142) in 2003 and 2004 and compared the data with 2003 Behavioral Risk Factor Surveillance System secondary data for comparison groups without MS (veteran population, n = 31,500; general population = 68,357). We compared disease prevalence by group and identified variables associated with chronic diseases in male veterans with MS.

Results
Overall, veterans with MS had a high prevalence of hypercholesterolemia (49%), hypertension (47%), diabetes (16%), coronary heart disease (11%), and stroke (7%). Overall and for the subset of people aged 50 years or older, diabetes, hypertension, hypercholesterolemia, coronary heart disease, and stroke were significantly more prevalent among male veterans with MS than among the general population. Diabetes, hypertension, hypercholesterolemia, and stroke were more prevalent overall among male veterans with MS than among the general veteran population; however, except for stroke, differences were not significant for the group aged 50 or older. Explanatory variables (eg, age, education, race) and dynamic associations between conditions (higher odds for each when ≥1 of the other conditions were present) for chronic disease in men with MS were similar to findings in the general population literature for select conditions.

Conclusion
These findings raise awareness of chronic disease in a veteran cohort and help bridge a gap in the literature on chronic disease epidemiology in men with MS. We identified chronic disease priorities that may benefit from focused interventions to reduce disparities.

Introduction

How idiosyncratic changes related to a person's primary disability, such as multiple sclerosis (MS), affect that person's health and aging process is unclear. Research suggests that people with MS experience more premature illness (1,2), which may result in the presence of more chronic diseases at a younger age, compared with the general population. Factors such as inactivity and immobility may place people with MS at increased risk of developing disabilities, and they may be disproportionately affected by chronic diseases (1,2). Comprehensive research on chronic disease prevalence among people with MS is lacking, especially among men with MS, since MS is more prevalent in women (3).

The Centers for Disease Control and Prevention (CDC) uses the Behavioral Risk Factor Surveillance System (BRFSS) to compile chronic disease prevalence data for the US population, but data specific to people with MS are unavailable. The Veterans Health Administration (VA) is a large health care system that provides care to approximately 28,000 people with MS, a substantial proportion of whom are male (88%) (4). These VA data can provide needed

epidemiologic data on chronic disease prevalence in men with MS.

Our objective was to identify chronic diseases that may disproportionately affect male veterans with MS. Diabetes, hypertension, hypercholesterolemia, coronary heart disease (CHD), and stroke were assessed because they are associated with the leading causes of illness and death in the United States (5).

Methods

Design

We collected primary data during 2003 and 2004 using a cross-sectional survey mailed to male veterans with MS. We obtained secondary data from the 2003 CDC BRFSS (6) to provide comparison group data for the general veteran population and general population. The institutional review board at the Hines VA Hospital and the Office for the Protection of Research Subjects at the University of Illinois at Chicago approved the study.

We used similarly worded questions from CDC BRFSS modules (6) to design the 65-item Multiple Sclerosis Health Care Questionnaire (MS-HCQ) (survey instrument available on request from the corresponding author) to collect primary data on sociodemographics, health behaviors, and chronic disease prevalence in veterans with MS. We included additional questions to assess MS duration and age at diagnosis.

The BRFSS survey is a standardized instrument used to monitor disease, health, and risk behaviors in the US population (50 states, the District of Columbia, Puerto Rico, Guam, and the US Virgin Islands). BRFSS data are collected annually from a probability sample of households with landline telephones. Trained interviewers conduct surveys by telephone. We obtained data from the 2003 BRFSS (6) for the general veteran population and general population comparison groups. Using formulas established by CDC, we weighted these data for selection probability (additional details may be found at www.cdc.gov/brfss/technical_infodata/weighting.htm).

Sample

VA researchers mailed surveys to a national cohort of veterans with MS who were members of a congressionally chartered veteran service organization (VSO). The sample included people with an MS diagnosis (confirmed by Veterans Benefits Department for VSO eligibility) who were both current users and nonusers of VA health care. We distributed surveys to 2,940 veterans with MS; 735 were returned undeliverable. A total of 1,305 veterans with MS (163 women, 1,142 men) returned completed surveys, resulting in a 59% (1,305 of 2,205) response rate.

There were 264,684 respondents to the 2003 BRFSS. We excluded data from 160,284 female respondents and 4,543 respondents whose data for veteran status were missing. Therefore, our study sample for comparison groups included 99,857 adult male respondents from the 2003 BRFSS. The general veteran population included respondents who served on active duty in the US Armed Forces and were retired or discharged from military service (n = 31,500); the remaining cohort comprised the male general population (n = 68,357). On the basis of Council of American Survey and Research Organizations guidelines, the 2003 BRFSS had a median response rate of 53% and a median interview completion rate of 77% (7).

Variables

Proportions of chronic disease prevalence were the main outcome measures, and these were determined by a yes response to questions asking whether they had ever been told by a health professional that they had the disease (diabetes, hypertension, hypercholesterolemia, CHD, or stroke).

Sociodemographic variables were age (continuous), race/ethnicity (self-identified as non-Hispanic white, non-Hispanic black or African American, Hispanic [any race], or other [Asian, Native Hawaiian/other Pacific Islander, American Indian or Alaska Native, or other]), education completed (<12 y, 12 y or equivalent, some college, or college graduate), employment status (employed, unemployed/able to work, unemployed/unable to work, or retired), marital status (married, divorced/separated, widowed, or never married), and geographic region of residence (South, West, Midwest, or Northeast, determined on the basis of US census regions using zip code). Health behavior variables were cigarette smoking (current, past, or never) and chronic drinking (having consumed ≥2 drinks/d in the past 30 days).

Statistical analyses

We calculated descriptive statistics for age at MS diagnosis (difference in MS diagnosis date and date of birth) and MS duration (difference in MS diagnosis date and survey return date). We conducted bivariate comparisons (*t* tests for continuous and X^2 tests for categorical variables) of male veterans with MS and each of the non-MS male comparison groups overall and for the subset of men aged 50 or older to assess differences between groups. We conducted multivariate analyses for the MS cohort for each chronic disease that resulted in significant bivariate associations between MS and both non-MS groups in the overall comparisons.

We used multivariate analyses to generate odds ratios (ORs) and 95% confidence intervals (CIs) to identify variables associated with the presence of each chronic disease in male veterans with MS. We built separate multivariate logistic regression models for diabetes, hypertension, hypercholesterolemia, and stroke, dichotomizing the dependent variable for each (disease present/not present). Covariates were age, race/ethnicity, age at MS diagnosis, education completed, employment status, marital status, region of residence, smoking and drinking status, and other chronic diseases.

Because of large CDC sample sizes and the potential for significance of small differences, we used random samples to test the significance of bivariate prevalence associations between the MS cohort and each of the CDC comparison groups. Random samples of 1,500 were used for comparisons between the non-MS groups and the MS group (n = 1,142), and random samples of 1,000 were used for the comparisons between the non-MS groups and the MS group (n = 962) for the subset aged 50 or older. To determine the random sample sizes, we calculated power using the Pearson X^2 test of 2 proportions (2-sided test, $P < .05$). We approximated numbers to attain 90% power and to detect a 5% difference in the number of people who had a chronic disease between the MS group and each non-MS group.

We conducted a separate analysis to assess whether the VSO survey respondents with MS were representative of the larger population of veterans with MS. Using VA administrative databases, we captured demographic data for people with MS (according to the *International Classification of Diseases, 9th Revision*, diagnosis code 340) who had used the VA health care system during the data collection period.

Significance was set at $P < .05$. We used SAS version 9.1 (SAS Institute, Inc, Cary, North Carolina) and Stata version 10 software (StataCorp LP, College Station, Texas) for statistical analyses.

Results

Participant characteristics

Mean age of MS diagnosis was 37 years, and the average number of years living with MS was 23. In each group, more than half of respondents were married, approximately one-third were college graduates, and the highest proportion of participants were white and resided in the South (Table 1). Compared with veterans with MS and the general veteran population, the general population was younger and a greater proportion was currently employed and never smoked. Chronic drinking was low among all groups, particularly among veterans with MS.

Chronic diseases

Prevalence of hypercholesterolemia, hypertension, diabetes, and stroke was higher among veterans with MS than among the general veteran and general populations (Table 2). Prevalence of CHD was significantly higher among veterans with MS than among the general population but not among the general veteran population. Among the subset of respondents aged 50 or older, prevalence of stroke was higher among veterans with MS than among the general veteran and general populations. Prevalence of CHD among respondents aged 50 or older was lower among veterans with MS than among the general veteran population and was higher among veterans with MS than among the general population. Prevalence of hypercholesterolemia, hypertension, and diabetes was significantly higher among veterans with MS only compared with the general population.

Multivariate analyses showed that the odds of having diabetes were higher among male veterans with MS who were older, non-Hispanic black or African American (vs white), and past smokers (vs current smokers) and who had hypertension, hypercholesterolemia, or a prior stroke (Table 3). Male veterans with MS who were college graduates had lower odds of having diabetes than their counterparts who did not complete high school. Widowed male veterans with MS were more than 2.5 times as likely to have hypertension as male veterans with MS who were currently married. The odds of having hypertension among male veterans with MS were higher with comorbid diabetes, hypercholesterolemia, prior stroke, and CHD, as well as for chronic drinkers.

Male veterans with MS who were non-Hispanic black or African American (vs white), lived in the Midwest (vs the South), or had a prior stroke had lower odds for hypercholesterolemia. The odds for hypercholesterolemia among male veterans with MS were higher with comorbid diabetes, hypertension, and CHD. Among male veterans with MS, the odds for having a stroke were lower with comorbid hypercholesterolemia but higher with concurrent asthma, CHD, diabetes, and hypertension. Older age at MS diagnosis was marginally associated with a higher risk of stroke.

Statistical association and representativeness

Presence or absence of significant associations remained across the 5 chronic diseases, with 1 exception: prevalence of diabetes was no longer significant in the MS population compared with the general veteran population (overall). VA administrative data showed comparable characteristics of veterans with MS (vs survey respondents): 86% male (vs 88%), mean age of 58 years (vs 61 y), 85% white (vs 91%), and 65% married (vs 75%).

Discussion

This study is the first comprehensive national examination of chronic disease prevalence in a large cohort of male veterans with MS compared with population-based CDC surveillance data.

Overall and for respondents aged 50 or older, diabetes, hypertension, hypercholesterolemia, CHD, and stroke were significantly more prevalent among male veterans with MS than among men in the general population. Likewise, diabetes, hypertension, hypercholesterolemia, and stroke were more prevalent, overall, in male veterans with MS than among the general veteran population, but only stroke was significantly more prevalent among the subset of respondents aged 50 or older. Although the higher prevalence of many chronic diseases in the MS cohort relative to the general population was anticipated, this study provided nationally representative estimates of the magnitude of these differences.

Diabetes

Some studies have reported lower diabetes prevalence among people with MS compared with other cohorts (8); others have reported higher diabetes prevalence among MS cohorts compared with the general population (9), which is consistent with our findings. Higher diabetes prevalence among people with MS may be attributable to muscle disease from nerve demyelination or to adrenocorticotropic hormone and glucocorticoid treatment (9).

We found that male veterans with MS who graduated college were less likely to have diabetes than those with less education, which is supported by reports that men who did not finish high school were more likely to have self-reported (10) and diagnosed (11) diabetes than those who had more education. We found that non-Hispanic black or African American male veterans with MS were nearly 3 times as likely as white male veterans with MS to have diabetes. This finding is similar to that of another study that found that black race was associated with increased odds of diabetes compared with white race but that controlling for education reduced the odds but retained significance (12). In veterans with MS, the disparity in diabetes risk for non-Hispanic black or African American men remained after controlling for education.

Similar to general medical literature, higher odds for diabetes was associated with hypercholesterolemia (13), prior stroke (13), and hypertension (75% of people with type 2 diabetes have hypertension [14]). Much of the illness and death associated with diabetes and its complications can be prevented or delayed by normalizing blood glucose levels, blood pressure, and lipids (15). Some complications that diabetes may lead to, such as vision problems and limb amputation (due to poor circulation) (15), may be more debilitating for people with MS, who often have mobility limitations. Early efforts are needed to screen men with MS who have comorbid conditions that are known risk factors for diabetes, with special focus on non-Hispanic black or African American men and people with less education.

Hypertension

Male veterans with MS who were chronic drinkers had increased odds of having hypertension, a relationship that has been well documented in the general population (16). Consistent with general medical literature, odds for hypertension in this study were higher with comorbid diabetes (17), CHD (18,19), hyperlipidemia (20), and stroke (21). We found that widowed male veterans with MS were 2.5 times as likely to have hypertension as their counterparts who were married. Becoming widowed may alter peoples' patterns of interaction in the health care system and informal care practices (eg, loss of a person who assists in care and supports self-care management); the associated negative health risks are elevated and long-term for widowed men (22). Not being married has been associated with poor adherence to taking hypertension medication (23). Furthermore, hypertension may be independently associated with an increased risk of ambulatory disability in people with MS (24), making it imperative to address to preserve function in this group.

Hypercholesterolemia

We found that non-Hispanic black or African American (vs white) race/ethnicity and residing in the Midwest (vs the South) were independently associated with lower odds of hypercholesterolemia in male veterans with MS. Gallup prevalence measures for hypercholesterolemia were comparable for both 2008 and 2009 (eg, white higher than black by ≥5 points and Midwest higher than South by ≥2 points) (25). Consistent with general medical literature, odds of hypercholesterolemia in men with MS were greater with CHD (26), hypertension (20), and diabetes (27). Studies have found different blood cholesterol and lipoprotein levels depending on the phase of clinical stability in which people with MS were (28), which may affect point prevalence values. Further understanding of the higher prevalence of hypercholesterolemia in veterans with MS is warranted, with special attention being paid to its presence in white men and people living in the South.

Stroke

People with MS may have a higher risk of stroke than people who do not have MS (29). Although the absolute value for stroke prevalence in our study was not alarming, disparities were evident across age groups in male veterans with MS compared with both non-MS groups. Comparable to general medical literature, odds of stroke were higher for people with diabetes (30,31), CHD (30), and hypertension (30). Stroke is a leading cause of death in people with MS (32) and is associated with high hospital use in people with MS (8). Strategies to raise awareness of increased stroke risk and

education on stroke warning signs specific to MS (eg, problems with balance/coordination and numbness/weakness may be difficult to distinguish) would be beneficial.

Limitations

The moderate response rate (59%) for the cohort of veterans with MS may have introduced nonresponse bias. These self-reported data are subject to recall bias. Differences may exist in responses provided by mail (MS-HCQ) versus telephone interview (BRFSS), although comparisons of BRFSS data from the 2 survey modes are "largely equivalent" (33). The comparison groups identified using secondary BRFSS data may have included people with MS, as exclusion was not possible; however, given the small numbers of people with MS relative to the general veteran and general populations (<1%), it is unlikely that chance inclusion of people with MS would have modified any true effect. Data were not available on factors that may influence chronic disease prevalence, such as nutrition, physical activity, genetic risk, or exacerbation periods and MS subtype. Findings from this study may be more generalizable than those of other MS research because the MS cohort is not limited to clinical or patient study samples (which may limit external validity and generate selection bias).

Conclusion

Overall, diabetes, hypertension, hypercholesterolemia, and stroke were significantly more prevalent among male veterans with MS than among men in both comparison groups. Nearly half of male veterans with MS had hypercholesterolemia and hypertension; these conditions occurring alone or concomitantly are implicated in many other diseases and should be addressed. Although a lower proportion of men were affected by stroke, the prevalence was consistently disparate across age groups. Future studies to examine age at onset and chronic disease severity relative to age- and sex-matched controls are needed to provide knowledge about premature morbidity and aging in people with MS. Further research is needed to understand the effects of clusters of comorbidites in this cohort. Research on the epidemiology of multiple chronic diseases in MS is scarce, and our findings help bridge a literature gap. We identified chronic disease priorities among male veterans with MS that may be targeted for early intervention to improve health and reduce disparities in this population.

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Tables

Table 1. Characteristics of Male Veterans With Multiple Sclerosis Compared With General Veteran and General Populations, United States, 2003-2004[a,b]

Return

Characteristic	Overall					Aged ≥50 Years				
	MS (n = 1,142)	GV (n = 31,500)	*P*[c]	GP (n = 68,357)	*P*[d]	MS (n = 962)	GV (n = 25,055)	*P*[c]	GP (n = 21,316)	*P*[d]
Mean age, y	60.8	59.1	.89	39.5	<.001	63.8	66.0	.79	60.5	.06
Race/ethnicity[e]										
Non-Hispanic white	91.0	81.4	<.001	66.6	<.001	92.8	85.6	<.001	73.1	<.001
Non-Hispanic black/African American	5.1	7.6	.002	8.7	<.001	4.2	5.6	.07	8.5	<.001
Hispanic, any race	2.7	5.8	<.001	16.4	<.001	2.1	4.5	<.001	11.5	<.001
Other	1.2	5.2	<.001	8.3	<.001	.9	4.3	<.001	6.9	<.001
Education completed										
<12 y	4.1	7.3	<.001	13.8	<.001	4.5	8.5	<.001	17.4	<.001
12 y or equivalent	17.9	31.4	<.001	29.5	<.001	18.6	30.3	<.001	25.5	<.001
Some college	45.3	29.5	<.001	23.8	<.001	43.1	26.9	<.001	18.9	<.001
College graduate	32.7	31.8	.49	32.9	.92	33.8	34.3	.73	38.2	.005
Employment status[f]										
Employed	6.2	49.7	<.001	80.2	<.001	4.6	37.7	<.001	57.5	<.001
Unemployed/able	2.2	3.8	.005	7.7	<.001	1.9	2.9	.07	4.9	<.001
Unemployed/unable	40.7	4.9	<.001	4.3	<.001	38.2	4.5	<.001	7.3	<.001
Retired	50.9	41.6	<.001	7.8	<.001	55.2	54.8	.79	30.3	<.001
Marital status										
Married	75.5	72.7	.04	57.4	<.001	77.4	76.7	.61	75.1	.11
Divorced/separated	16.8	12.8	<.001	9.1	<.001	15.7	11.0	<.001	12.5	.002
Widowed	3.1	6.4	<.001	1.4	<.001	3.3	8.3	<.001	4.9	.02
Never married	4.6	8.1	<.001	32.1	<.001	3.7	4.0	.61	7.5	<.001
Geographic region of residence										
South	29.5	39.7	<.001	36.4	<.001	28.5	38.3	<.001	37.0	<.001
West	22.9	22.1	.54	23.7	.53	23.7	22.2	.26	21.5	.10

Midwest	21.1	20.5	.58	20.7	.75	21.7	21.0	.62	21.3	.77
Northeast	26.5	17.7	<.001	19.2	<.001	26.1	18.5	<.001	20.2	<.001
Cigarette smoking status										
Current	16.1	22.8	<.001	25.7	<.001	14.0	17.6	.004	18.9	<.001
Past	63.5	46.1	<.001	22.4	<.001	66.9	53.9	<.001	40.3	<.001
Never	20.4	31.1	<.001	51.9	<.001	19.1	28.6	<.001	40.8	<.001
Chronic drinker[g]	2.8	5.6	<.001	7.2	<.001	2.9	4.8	.006	5.1	.003

Abbreviations: MS, veterans with multiple sclerosis; GV, general veteran population; GP, general population.
[a] Unweighted total sample sizes. All data are reported as weighted percentages unless otherwise indicated.
[b] Item response for all variables was ≥96%.
[c] Significance indicated for male veterans with MS vs men in the general veteran population; calculated using X^2 test (except for age, which was calculated using *t* test).
[d] Significance indicated for male veterans with MS vs men in the general population; calculated using X^2 test (except for age, which was calculated using *t* test).
[e] Race/ethnicity was self-identified. Hispanic ethnicity included any identified race (or none). Other included Asian, Native Hawaiian/Pacific Islander, American Indian or Alaska Native, or other.
[f] Employed included employed for wages or self-employed; unemployed was categorized as able to work or unable to work.
[g] Chronic drinkers were defined as having consumed ≥2 drinks per day in the past 30 days.

Table 2. Prevalence of Chronic Diseases Among Male Veterans With Multiple Sclerosis Compared With General Veteran and General Populations, United States, 2003-2004[a,b]

Return

	Overall					Aged ≥50 Years				
Chronic Illness	**MS (n = 1,142)**	**GV (n = 31,500)**	***P*[c]**	**GP (n = 68,357)**	***P*[d]**	**MS (n = 962)**	**GV (n = 25,055)**	***P*[c]**	**GP (n = 21,316)**	***P*[d]**
Coronary heart disease	10.5	11.5	.30	3.3	<.001	12.1	15.0	.01	9.4	.007
Diabetes	15.9	13.6	.02	5.6	<.001	17.8	16.7	.37	14.5	.004
Hypercholesterolemia	48.5	44.6	.008	30.9	<.001	49.7	48.6	.49	44.8	.002
Hypertension	46.7	41.2	<.001	20.9	<.001	49.9	48.1	.26	42.1	<.001
Stroke	7.0	4.2	<.001	1.4	<.001	7.9	5.3	<.001	4.1	<.001

Abbreviations: MS, veterans with multiple sclerosis; GV, general veteran population; GP, general population.
[a] Unweighted total sample sizes. Data are reported as weighted percentages.
[b] Item response for all variables was ≥90%.
[c] Significance indicated for male veterans with MS vs men in the general veteran population; calculated using X^2 test.
[d] Significance indicated for male veterans with MS vs men in the general population; calculated using using X^2 test.

Table 3. Variables Associated With Chronic Diseases in Male Veterans With Multiple Sclerosis, United States, 2003-2004

Return

Variable	**Diabetes,[a] OR (95% CI)**	***P***	**Hypertension,[a] OR (95% CI)**	***P***	**Hyperchol-esterolemia,[a] OR (95% CI)**	***P***	**Stroke,[a] OR (95% CI)**	***P***
Age	1.03 (1.00-1.05)	.03	1.02 (1.00-1.03)	.06	0.99 (0.97-1.00)	.10	1.03 (0.99-1.07)	.15
Race/ethnicity								
Non-Hispanic white	1	NA	1 [Reference]	NA	1 [Reference]	NA	1	NA

	[Reference]						[Reference]	
Non-Hispanic black/African American	2.78 (1.26-6.12)	.01	0.93 (0.48-1.81)	.83	0.51 (0.26-1.00)	.05	1.04 (0.32-3.32)[b]	.95[b]
Hispanic, any race	1.69 (0.54-5.29)	.37	0.63 (0.25-1.55)	.31	0.63 (0.27-1.47)	.28		
Other	1.88 (0.36-9.90)	.46	1.09 (0.31-3.93)	.89	0.71 (0.21-2.45)	.59		
Age at MS diagnosis	1.00 (0.98-1.01)	.59	1.01 (0.99-1.02)	.53	1.00 (0.99-1.02)	.61	1.03 (1.00-1.06)	.07
Education completed								
<12 y	1 [Reference]	NA	1 [Reference]	NA	1 [Reference]	NA	1 [Reference]	NA
12 y/equivalent	0.73 (0.29-1.83)	.50	1.34 (0.59-3.05)	.48	1.03 (0.46-2.31)	.95	0.55 (0.11-2.63)	.45
Some college	0.54 (0.23-1.29)	.17	1.08 (0.49-2.38)	.84	1.41 (0.65-3.05)	.39	0.54 (0.13-2.18)	.38
College graduate	0.32 (0.13-0.79)	.01	1.08 (0.49-2.39)	.85	1.33 (0.61-2.90)	.48	0.84 (0.21-3.32)	.80
Employment status								
Employed	1 [Reference]	NA	1 [Reference]	NA	1 [Reference]	NA	1 [Reference]	NA
Unemployed/able	1.94 (0.47-8.03)	.36	0.41 (0.13-1.27)	.12	2.01 (0.69-5.88)	.20	NA[c]	NA[c]
Unemployed/unable	1.04 (0.43-2.55)	.92	1.03 (0.58-1.83)	.92	1.10 (0.63-1.94)	.74	NA[c]	NA[c]
Retired	1.02 (0.42-2.52)	.96	1.03 (0.58-1.85)	.91	1.25 (0.70-2.23)	.45	NA[c]	NA[c]
Marital status								
Married	1 [Reference]	NA	1 [Reference]	NA	1 [Reference]	NA	1 [Reference]	NA
Divorced/separated	0.82 (0.47-1.44)	.49	0.96 (0.65-1.41)	.83	0.83 (0.56-1.21)	.33	1.17 (0.50-2.70)[b]	.72[b]
Widowed	0.43 (0.12-1.52)	.19	2.54 (1.02-6.33)	.05	2.36 (0.97-5.77)	.06		
Never married	0.15 (0.02-1.15)	.07	0.92 (0.46-1.84)	.81	0.60 (0.30-1.20)	.15		
Geographic region of residence								
South	1 [Reference]	NA	1 [Reference]	NA	1 [Reference]	NA	1 [Reference]	NA
West	0.73 (0.42-1.26)	.26	1.02 (0.69-1.49)	.94	0.90 (0.61-1.31)	.57	0.47 (0.18-1.26)	.13
Midwest	0.61 (0.35-1.08)	.09	1.11 (0.75-1.65)	.60	0.57 (0.39-0.85)	.006	0.84 (0.34-2.06)	.69
Northeast	1.07 (0.65-1.74)	.80	0.81 (0.56-1.17)	.27	0.86 (0.60-1.24)	.42	0.55 (0.22-1.41)	.22
Cigarette smoking status								
Current	1 [Reference]	NA	1 [Reference]	NA	1 [Reference]	NA	1 [Reference]	NA

Past	1.90 (1.00-3.58)	.05	1.16 (0.77-1.74)	.49	0.78 (0.52-1.17)	.23	0.60 (0.22-1.63)	.31
Never	1.15 (0.54-2.46)	.72	1.15 (0.72-1.86)	.56	0.70 (0.44-1.12)	.14	0.80 (0.27-2.42)	.69
Chronic drinker	1.32 (0.40-4.29)	.65	2.65 (1.00-7.03)	.05	1.72 (0.64-4.58)	.28	NA[c]	NA[c]
Asthma	1.10 (0.51-2.36)	.81	0.93 (0.53-1.64)	.81	1.14 (0.65-1.99)	.64	5.18 (2.11-12.73)	<.001
CHD	1.44 (0.80-2.62)	.23	1.92 (1.13-3.25)	.02	3.17 (1.82-5.52)	<.001	5.78 (2.65-12.61)	<.001
Diabetes	NA	NA	2.11 (1.42-3.13)	<.001	2.15 (1.44-3.21)	<.001	3.07 (1.44-6.54)	.004
Hypertension	2.15 (1.45-3.19)	<.001	NA	NA	1.81 (1.37-2.40)	<.001	2.38 (1.14-4.95)	.02
Hyperchol-esterolemia	2.16 (1.45-3.24)	<.001	1.81 (1.37-2.39)	<.001	NA	NA	0.43 (0.21-0.89)	.02
Stroke	3.11 (1.46-6.63)	.003	2.54 (1.19-5.41)	.02	0.43 (0.21-0.89)	.02	NA	NA

Abbreviations: OR, odds ratio; CI, confidence interval; NA, not applicable; MS, multiple sclerosis; CHD, coronary heart disease.

[a] Sample size for diabetes, hypertension, and hypercholesterolemia was n = 943; stroke, n = 950.

[b] Combined variable categories for inclusion in stroke regression model due to small cell sizes. For race, combined non-Hispanic black/African American, Hispanic, and other because n <5 for each and for marital status combined never married (n = 2) and widowed (n = 6) with divorced/separated.

[c] Unable to include employment status and chronic drinker in the stroke regression model due to inadequate cell sizes. (Of persons with stroke, only 2 chronic drinkers and only 2 in the employed reference group).

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SPECIAL TOPIC

A Population Approach to Mitigating the Long-Term Health Effects of Combat Deployments

Heather Schacht Reisinger, PhD; Stephen C. Hunt, MD, MPH; A. Lucile Burgo-Black, MD; Madhulika A. Agarwal, MD, MPH

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PEER REVIEWED

Abstract

A major focus of the mission of the US Department of Veterans Affairs (VA) is to respond to the needs of military personnel returning from war. Given the broad spectrum of the potential effects of combat deployment on the health and well being of service members, VA is increasingly oriented toward comprehensive postcombat support, health promotion, disease prevention, and proactive approaches to caring for combat veterans. This article briefly summarizes the health care needs of service members returning from Afghanistan and Iraq, describes VA's approaches to addressing their needs, and outlines VA's evolving vision for how to apply principles of population health management to ensure prompt and effective response to the postdeployment needs of veterans returning from future conflicts. At the heart of postcombat care will be population-based approaches oriented to health recovery using interdisciplinary, team-based platforms.

Introduction

Throughout its history, a major focus of the mission of the US Department of Veterans Affairs (VA) has been to respond to the needs of military personnel returning from war. Given the broad spectrum of potential effects of combat deployment on the health and well-being of service members, VA is oriented toward comprehensive postcombat support, health promotion, disease prevention, and proactive approaches to caring for combat veterans. One goal of such care is to prevent or mitigate chronic health impairments. This article briefly summarizes the health care needs of service members of Operation Enduring Freedom in Afghanistan (OEF), Operation Iraqi Freedom (OIF) (2003-2010), and Operation New Dawn in Iraq (OND) (2010-present); describes VA's role in addressing the needs of combat veterans; and outlines VA's evolving vision for how to apply principles of population health management to ensure prompt, effective, and sustained response to the postdeployment health needs of veterans returning from future conflicts.

Health Concerns of Veterans of Afghanistan and Iraq Deployments

Although the impact of OEF/OIF/OND is most visible in the physical injuries sustained on the battlefield, serving in combat areas affects veterans in various ways and results in a wide array of postcombat needs. Seventy-five percent of combat casualties in the current conflicts are due to explosive mechanisms of injury, primarily improvised explosive devices (1). These explosions can result in physical injury to limbs, concussion, traumatic brain injury (TBI), burns, blinding, and hearing loss. Advances in body armor and frontline medical response have increased the survival rate of soldiers with battlefield injuries (2). Sustaining such injuries, witnessing such events, and maintaining constant vigilance for such attacks also carry psychological risk. Cumulative or recurrent physical injuries and psychological traumas, along with the challenges of repetitive transitions between deployed and nondeployed status, are compounded by innumerable concomitant social and economic consequences (3).

Many injured service members have what VA has termed "polytrauma," or multiple injuries from a single event

involving a complex array of discrete, often co-occurring, medical conditions with overlapping symptoms (4). Prevalence rates, which provide an inventory of injuries, often do not reveal co-occurrence of conditions, and hence belie the impact of multiple injuries on 1 person. More than 229,000 Armed Forces personnel have been diagnosed as having TBI since 2000 (5), and recent studies found that 10% to 23% of OEF/OIF service members screened positive for TBI (6,7). In the VA as of August 2011, 561,000 OEF/OIF veterans have been screened for TBI, 111,000 had an initial positive screen, and 43,000 had a confirmed TBI diagnosis after a comprehensive evaluation.With regard to mental health concerns, among Army and Marine Corps returnees from Iraq, 27% to 36% meet criteria for the broad definition of a mental health disorder 3 to 6 months after returning from deployment, including depression (10%-13%) and posttraumatic stress disorder (PTSD) (17%-25%) (8). One study found that 37% of OEF/OIF veterans receiving VA health care were diagnosed with a mental health disorder (9). Recent research has focused on the "polytrauma clinical triad," or the co-occurrence of TBI, PTSD, and chronic pain (10). In 1 study at a VA polytrauma site, a review of medical records revealed that 42.1% of the OEF/OIF patient sample were diagnosed with all 3 conditions (11). Those with all 3 conditions are also more likely to experience variability in depressed heart rates and cardiac complications (12). Although the prevalence and impact of auditory and visual impairment is understudied, 1 study of VA OEF/OIF patients found visual impairment ranged from 8.5% to 15.7%; auditory impairment, from 21.0% to 33.0%; and dual sensory impairment, from 22.7% to 35.4%; those with blast exposure had the highest rates (13). Many injured service members are recovering from numerous co-occurring conditions, including TBI, pain, amputation, visual and hearing impairment, aphasia, and PTSD, along with other mental health conditions. Besides physical injuries and mental health disorders, combat exposures increase propensity for engaging in risk behaviors, including excessive and binge drinking, verbal or physical aggression, and seeking dangerous activities (14). Finally, many returning service members face postdeployment challenges with social relationships and community reintegration (3,15). The key to providing care for this cohort of veterans has been to implement a systematic, comprehensive, and integrated approach to needs assessment and care delivery.

VA Response: Population Health

The VA approach to health care for combat veterans is based on the standard model of population health management: the use of primary, secondary, and tertiary prevention to optimize health outcomes for OEF/OIF/OND service members (Figure). VA has developed programs and services to respond at all levels of the population health model, from veterans who have sustained devastating physical injuries to those who need and seek nothing more than readjustment advice, and for all of the veterans along that spectrum. This article focuses on the programs specific to veterans returning from Afghanistan and Iraq (Table).

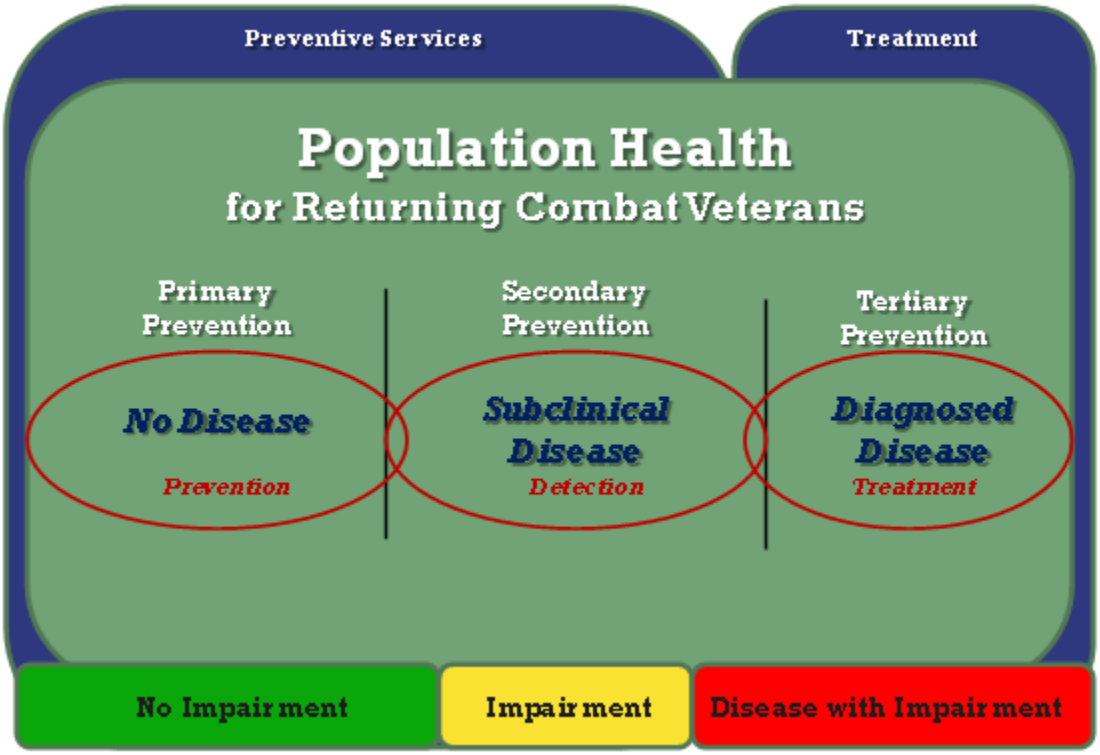

Figure. Levels of population health as applied to postcombat care. Primary prevention includes veterans with no disease who receive preventive services. Secondary prevention is screening to detect subclinical disease. Tertiary

prevention is management of disease. [A text description of this figure is also available.]

Primary prevention

During the past 20 years, primary prevention has assumed a more prominent role in the VA health care system and has shifted to population-based, patient-centered primary care (16). VA uses primary prevention to promote a healthy, disease-free population of veterans, for example, through smoking cessation programs and counseling regarding diet and exercise (17). These programs have also been tailored to meet the unique needs of OEF/OIF/OND veterans. For example, VA has recently partnered with the US Department of Defense (DoD) to promote a website for tobacco cessation (www.ucanquit2.org) designed to meet the needs of younger active military and veteran populations. OEF/OIF research has found that veterans with PTSD and other mental health conditions have higher rates of tobacco use, hypertension, hyperlipidemia, and obesity compared with veterans without mental health diagnoses, so an emphasis on primary prevention is particularly relevant for this population (18).

The current transition in VA to a medical-home model of care delivery, called patient-aligned care teams (PACT), strengthens the population-based approach while focusing attention on individual patients. The objective of a medical-home model is to place the patient at the center of a health care team that examines the patient's current health status, monitors his or her long-term health and disease trajectory, and coordinates and manages his or her overall medical care. The strength of the medical-home model in supporting population-based health has been demonstrated in other health care delivery systems (19). VA's use of electronic health record (EHR) systems also contributes to its ability to support population-based health for combat veterans through assessment of outcomes stratified by a provider's or primary care team's patient panels or by patient diagnoses. Point-of-care clinical reminder systems permit standardized screening and risk assessment, and capabilities for real-time clinical decision support are evolving.

Secondary prevention

The initial step of comprehensive care for all returning combat veterans is standardized assessments and screenings, which may reveal unacknowledged, unrecognized, and undiagnosed disease or illness. Here, the VA health care system moves to secondary prevention, or early detection and case finding of subclinical disease. All OEF/OIF/OND veterans in the VA health care system are flagged in the EHR for specific screening assessments. These screenings may help providers detect mental health conditions, such as depression, PTSD, or suicide risk. They also allow for documentation of blast exposures and prompt referrals for veterans to receive more intensive evaluation based on this history. An OEF/OIF registry has been developed to facilitate treatment, monitoring, and research related to various war-related illnesses. VA has also initiated a TBI registry to establish a database of all veterans who have symptoms possibly resulting from TBI or who have a TBI diagnosis. Secondary prevention, early detection, and case finding are strengthened by population screening, an extensive system of clinical reminders in VA's EHR, and deployment-related registries.

Tertiary prevention

Finally, the notion of "veteran health care" generally brings to mind what is considered to be tertiary prevention in terms of the population health model: the diagnosis and management of clinical disease (both clinical management and patient self-management) to reduce long-term impairments. VA has numerous programs to treat and rehabilitate veterans with war-related injuries. The first step in treating injured service members is to ensure a smooth transition from DoD to VA health care facilities. After leaving a DoD medical treatment facility, a veteran may transition to different levels of care within VA depending on the extent of his or her injuries. Veterans who have sustained a spinal cord injury will receive care at 1 of 21 VA Spinal Cord Injury Centers until they are ready to return home (20). Those who have sustained multiple, extensive injuries may first receive care at 1 of 5 national Polytrauma Rehabilitation Centers (21). When clinically appropriate, the veteran will be transitioned to a VA medical center closer to home for continued rehabilitation and recovery. The polytrauma centers focus on interdisciplinary, integrated care; VA's national health care system and EHR allow for seamless transitions within or between VA facilities. Rehabilitation programs in local VA medical centers offer physical, occupational, and vocational therapy, as well as surgical, prosthetic, and other specialty support.

Postdeployment services are integrated for the veteran within and between programs. VA is currently undergoing a transformation in its basic platform of care to the PACT model of veteran-centered, team-based care coordinated around the needs and preferences of the individual veteran. For returning combat veterans, this transformation requires PACT alignment with mental health, social work, OEF/OIF/OND care management, suicide prevention, polytrauma, pain management, and women's health programs. Further integration of the services and resources of these programs is accomplished through the interdisciplinary, primary care–based Post-Deployment Integrated Care Initiative, which provides education, training, and support for postcombat care in VA medical centers nationwide. This initiative works closely with the Primary Care-Mental Health program, which has greatly enhanced integration of mental health care into primary care in VA. System-wide care for combat veterans is a component of the recently implemented PACT model. The core principles of all these programs include continuously improving care that is veteran-centered, team-based, case managed, and evidence-based. The objective is to assess the veteran

comprehensively for postdeployment care needs (ie, physical, psychological, and psychosocial), to appropriately triage the veteran, to create an interdisciplinary care plan, and to monitor the veteran based on intensity of needs.

Encouraging all OEF/OIF/OND veterans to access VA health care and enhancing collaborative efforts between VA and other agencies are part of VA's population-based approach. The Vet Centers, originally established after the Vietnam War to provide counseling for veterans in less formal settings outside VA facilities, have incorporated OEF/OIF/OND veterans into their mission and continue to provide an open, destigmatized, and confidential place where veterans can seek help (22). Three War Related Illness and Injury Study Centers operate across the country and offer education, training, clinical services, and research support to VA facilities regarding the health effects of war (23). Finally, VA has reached out to veterans' families and caregivers, helping them get veterans access to the care they need and, more recently, providing educational, counseling, and financial support to caregivers who provide care and help veterans recover function.

Improving Postcombat Care in the VA

Many efforts are underway for improving VA care for returning combat veterans. All combat veterans can receive no-fee VA care for potentially service-related concerns for 5 years following discharge from active duty. The transition of care from DoD to VA for veterans of the current conflicts is complicated by the fact that half of the members of the military deployed to Iraq and Afghanistan have been members of the Reserve and the National Guard. Many have been deployed more than once and in the process have experienced numerous transitions in care between DoD and VA as they shift in and out of active duty status. To help with these transitions in care, VA and DoD have collaborated on many projects, including creation of a shared medical record system. VA and DoD have developed liaison programs to help service members and their families transition from military treatment facilities to VA facilities, as well as outreach programs for service members who are not seriously injured but who may need help with reintegration. Coordination of care in these transitions between VA and DoD is necessary to avoid gaps in care. When a service member is discharged and becomes a veteran or a National Guard soldier returns home from active duty, VA seeks to begin providing comprehensive care.

VA is a national system of health care with 153 medical centers and more than 900 community-based outreach clinics, but the full range of comprehensive services is geographically dispersed and not available in every veteran's home community. To meet the distance barrier, VA is using new telehealth technologies to bring specialty care closer to the veteran.

VA's Vision for Preparedness

VA must provide high-quality, interdisciplinary, integrated care to combat veterans to ensure they recover their optimal health and reintegrate successfully into civilian society and postwar life. VA has developed effective strategies and approaches to serve needs of veterans returning home from war. During times of peace, as an essential part of our national infrastructure of preparedness, these capabilities for postdeployment care must be maintained and ready for activation. Preparing for future conflicts will entail understanding the potential environmental agent or toxic exposures service members may face in fields of combat and remaining abreast of advances in battlefield and military technology. Our postcombat care system must include collaborative relationships among VA, DoD, and other government and community agencies, and integrated records systems to identify and track emerging symptoms, illnesses, and injuries. The system must have training plans to educate VA and community providers on needs of returnees and appropriate screening tools to detect past physical and mental health issues in new contexts. VA's doors should remain open to service members and their families who are struggling with readjustment, and VA should have the capability of quickly putting together a national response that allows recovering veterans to transition seamlessly to civilian life and to do so closer to home. At the center of preparedness for war will be a population-based approach to health recovery that uses interdisciplinary teams for postcombat care.

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Tables

Table. VA Programs Related to OEF/OIF/OND Postdeployment Care Categorized by Levels of the Population Health Model (Primary, Secondary, and Tertiary Prevention)

Return

Programs Directed at 3 Levels of Prevention		
Primary Prevention	**Secondary Prevention**	**Tertiary Prevention**
Outreach to OEF/OIF/OND veterans and their families Education and training programs for communities, families, and veterans • Primary care • Mental health care • Social work • OEF/OIF/OND Care Management Program • Pain Management • Women Veterans Health Care • Polytrauma Rehabilitation Centers • Spinal Cord Injury centers • Office of Public Health Health care team monitoring current health status to prevent future illness and chronic disease (eg, smoking cessation counseling, weight loss counseling) Immunizations	Screening and assessment • Flagged in electronic health record (EHR) for OEF/OIF/OND veterans • EHR clinical reminder with screening for posttraumatic stress disorder, suicide risk, and other mental health conditions; traumatic brain injury and blast exposure history OEF/OIF veteran registries	Liaison program for transition from military treatment facility to VA medical center Polytrauma Rehabilitation Centers Spinal Cord Injury Centers Physical therapy, occupational therapy, and vocational rehabilitation (every VA medical center) Patient Aligned Care Teams — integrated care at all VA medical centers and community based clinics • Primary care • Mental health care • Social work • OEF/OIF/OND Care Management Program • Pain Management Program • Women Veterans Health Care • Other specialty services
Programs, Services, and Tools for Integrating Veteran Health Care Across 3 Levels of Prevention		
Patient Aligned Care Teams — modeled after Patient Centered Medical Homes Electronic Health Records Post-Deployment Integrated Care Initiative — education, training, and support for postcombat care across VA War Related Illness and Injury Study Centers Vet Centers		

Abbreviations: VA, US Department of Veterans Affairs; OEF, Operation Enduring Freedom; OIF, Operation Iraqi Freedom; OND, Operation New Dawn.

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ORIGINAL RESEARCH

Benefits of a Primary Care Clinic Co-Located and Integrated in a Mental Health Setting for Veterans With Serious Mental Illness

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PEER REVIEWED

Abstract

Introduction
Efficacy trials have shown that primary care co-located in the mental health setting improves the receipt of high-quality medical care among people with serious mental illness. We tested whether implementation of such a program affected health service use and cardiovascular risk factor control among veterans with serious mental illness who had previously demonstrated limited primary care engagement.

Methods
We performed a cohort study of veterans enrolled in a co-located, integrated primary care clinic in the mental health outpatient unit through targeted chart review. Two successive 6-month periods in the year before and in the year following enrollment in the co-located primary care clinic were examined for primary care and emergency department use and for goal attainment of blood pressure, fasting blood lipids, body mass index (BMI), and, among patients with diabetes, hemoglobin A1c (HbA1c). We used repeated-measures logistic regression to analyze goal attainment and repeated measures Poisson regression to analyze service use.

Results
Compared with the period before enrollment, the 97 veterans enrolled in the clinic had significantly more primary care visits during 6 months and significantly improved goal attainment for blood pressure, low-density lipoprotein cholesterol, triglycerides, and BMI. Changes with regard to goal attainment for high-density lipoprotein cholesterol and HbA1c were not significant.

Conclusion
Enrollment in a co-located, integrated clinic was associated with increased primary care use and improved attainment of some cardiovascular risk goals among veterans with serious mental illness. Such a clinic can be implemented effectively in the mental health setting.

Introduction

Cardiovascular disease (CVD) risk factors are common among patients with serious mental illnesses (SMI) such as schizophrenia, schizoaffective disorder, and bipolar disorder (1-7). The quality of care for CVD is poor in patients with SMI, and their CVD risk factors are commonly missed or ignored (8).

Veterans with SMI have fewer medical visits than do other US Veterans Administration (VA) patients (9). SMI patients primarily seek care for mental health conditions rather than for physical conditions (8), so the mental health setting may be a more effective "home" site for primary care services (10). Co-location and integration of primary care services in the mental health setting is an innovation that may reduce some of the barriers to delivery and receipt of high-quality medical care among patients with SMI (11,12). Co-location refers to the placement of primary care providers in

the mental health setting, and integration is coordination of care with mental health providers (13). Previous studies of this care model have shown an increase in primary care visits, improved attainment of performance measures, and reduced emergency department use (11,14-17). However, these studies were limited in their ability to demonstrate that co-located care can be implemented in a clinical setting and to assess the effect of the clinic on CVD risk management. This is because these studies were done in an experimental setting, did not examine within-patient changes, or did not study the effect on cardiovascular measures.

We explored the effect of enrollment in a primary care clinic co-located and integrated in the outpatient mental health program on service use and control of CVD risk among veterans with SMI. We hypothesized that enrollment in this clinic would improve primary care access, reduce emergency department visits and hospitalizations, and improve control of CVD risk factors.

Methods

Serious Mental Illness Primary Care Clinic

The Serious Mental Illness Primary Care Clinic (SMIPCC) was implemented at the Providence VA Medical Center in March 2008. SMIPCC is a primary care clinic co-located and integrated in the mental health outpatient program. It is open 1 session per week and staffed by a single primary care provider and a patient care assistant. SMIPCC uses open-access scheduling. As much as possible, primary care visits coincide with scheduled mental health visits, although patients are sometimes asked to return at other times. Patients can also walk in for care. All patients seeking care are seen the same day.

To be enrolled in SMIPCC, a veteran must have a chronic and active mental health condition that leads to a high frequency of mental health service use. Veterans must have demonstrated poor access to primary care by having had at least 1 no-show or 2 “cancellations by patient” of a scheduled primary care visit in the prior 2 years; veterans not yet enrolled in primary care are also eligible. To support the care integration, the patient must have a mental health visit scheduled on the morning that SMIPCC is open or be enrolled in a mental health case management program that can assist with care coordination. The patient must have at least 1 concurrent medical diagnosis that is chronic and must agree to receive primary care through SMIPCC.

Study population and design

We performed a longitudinal cohort study of all veterans enrolled in SMIPCC. The only inclusion criterion for the study was enrollment in SMIPCC for at least 1 year; there were no study exclusion criteria. Our study was approved by the Providence VA Medical Center institutional review board, and, because this was a chart review study with no direct patient contact, an informed consent waiver was granted.

Data collection

We abstracted all data from electronic medical records. Demographic information at the time at which the patient initiated participation in SMIPCC included age, sex, race/ethnicity, marital status, comorbid medical and psychiatric conditions, and VA service connection. We treated age as a continuous variable. We categorized race/ethnicity as white non-Hispanic or not. Medical comorbidity was evaluated using the Charlson-Deyo comorbidity index (18). This score is calculated on the basis of the number of diseases (determined by using *International Classification of Diseases, 9th Revision* [ICD-9] codes), which are then weighted on the basis of 1-year risk of death; the sum of the weighted disease count is the score. Service connection is a rating the VA provides on the basis of degree of disability and association with military service that is used to determine the level of benefits for which a veteran is eligible from the VA. We classified VA service connection as not service connected, less than 50% service connected, or 50% to 100% service connected.

We used 4 observation windows: T1 and T2 were the 2 successive 6-month periods in the year before enrollment in SMIPCC, and T3 and T4 were the 2 successive 6-month periods of enrollment. T1 started exactly 1 year before enrollment in SMIPCC, T2 started 6 months before the date of enrollment, T3 started with the date of enrollment, and T4 started 6 months after the date of enrollment.

In each observation window, we collected data on blood pressure at scheduled outpatient visits (ie, not including emergency department or inpatient measurements), body mass index (BMI), low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides, and, among those with diabetes, hemoglobin A1c (HbA1c). For measures recorded more than once, we used the average value in the observation window.

Goal attainment outcomes were based on established performance measures (19). Goal blood pressure was systolic blood pressure less than 140 mm Hg and diastolic blood pressure less than 90 mm Hg; for patients with diabetes or coronary artery disease, goal blood pressure was less than 130 mm Hg systolic and 80 mm Hg diastolic. The goal for BMI, which was calculated by dividing the patient’s weight by the square of the patient’s height, was less than 30

kg/m . Goal LDL cholesterol was less than 130 mg/dL, unless there was comorbid diabetes or coronary artery disease, in which case the goal was less than 100 mg/dL. Goal HDL cholesterol was more than 40 mg/dL for men and more than 50 mg/dL for women. Triglyceride goal was less than 150 mg/dL. Among patients with diabetes, goal HbA1c was less than 9%. For all measures, we considered missing data in an observation window to be not attained.

We examined health service use by using data from two 6-month observation windows, 1 for pre-enrollment (the 6-month period beginning exactly 1 calendar year before enrollment) and 1 for postenrollment (the 6-month period beginning 90 days after enrollment). We obtained the count of primary care visits to providers (physicians and nurse practitioners), emergency department visits (nonpsychiatric-related), and medical/surgical hospital admissions in these 6-month windows. We also recorded whether a primary care visit with a primary care provider was on the same day as a scheduled mental health visit of any type.

Analyses

We used repeated measures logistic regression to examine the attainment of goal blood pressure, LDL and HDL cholesterol, triglycerides, BMI, and HbA1c, from pre-enrollment to postenrollment. To do this, the patient was considered to be the repeated effect, with time designated as a within-subjects factor. We specified a first-order autoregressive covariance structure based on the anticipated within-subject correlations with respect to time. We first examined the designation of pre-enrollment or postenrollment as the sole covariate in the fixed-effect portion of the model, then added age, sex, race/ethnicity, Charlson-Deyo comorbidity index score, and VA service connection to the fixed-effects models. We also examined actual measured values with a similar approach, using generalized linear models.

We performed several sensitivity analyses. We limited analysis to only windows T1 and T2 to test for temporal trends before enrollment. We examined our findings for attainment of goals, excluding patients with missing values (ie, treated as missing rather than not attaining goal). We repeated analyses using only patients who had transferred from usual primary care into SMIPCC (ie, excluded those who were new to VA primary care at the time of SMIPCC enrollment) to test whether transfer of primary care conferred a benefit. Finally, we focused only on patients with known coronary artery disease, diabetes, or both.

For service use data, we used repeated-measures Poisson regression. We first examined enrollment as a sole fixed effect, then added age, sex, race/ethnicity, Charlson-Deyo comorbidity index score, and VA service connection to the fixed-effects portion of the models. We used repeated measures logistic regression to examine the odds of a primary care visit concurrent with a mental health visit before and after enrollment. Few patients had a medical/surgical hospitalization in either observation window (1 in the 6 months before and 4 in the 6 months after enrollment), so we did not perform statistical tests on this measure. All analyses were performed using SAS version 9.1 (SAS Institute Inc, Cary, North Carolina), and significance was set at $P < .05$.

Results

Most veterans in our study (N = 97) were male and non-Hispanic white, and mean age was 55.3 years (range, 28-86 y) (Table 1). The median Charlson-Deyo comorbidity index was 1, with an interquartile range (IQR) of 2 (0-2); 10% of the population had a score of 3 or more.

Goal attainment

In the repeated-measures logistic regression models, enrollment in SMIPCC was associated with higher goal attainment for blood pressure (adjusted odds ratio [AOR] = 2.16; 95% confidence interval [CI], 1.47-3.18), LDL cholesterol (AOR = 1.60; 95% CI, 1.10-2.34), triglyceride (AOR = 1.64; 95% CI, 1.06-2.51), and BMI (AOR = 1.81; 95% CI,1.29-2.54) (Figure). No significant difference was found for goal HDL cholesterol or HbA1c. There were no differences between measured values across observation windows (Table 2), but the number of patients for whom the measure was obtained was lower in windows T1 and T2 (ie, before enrollment).

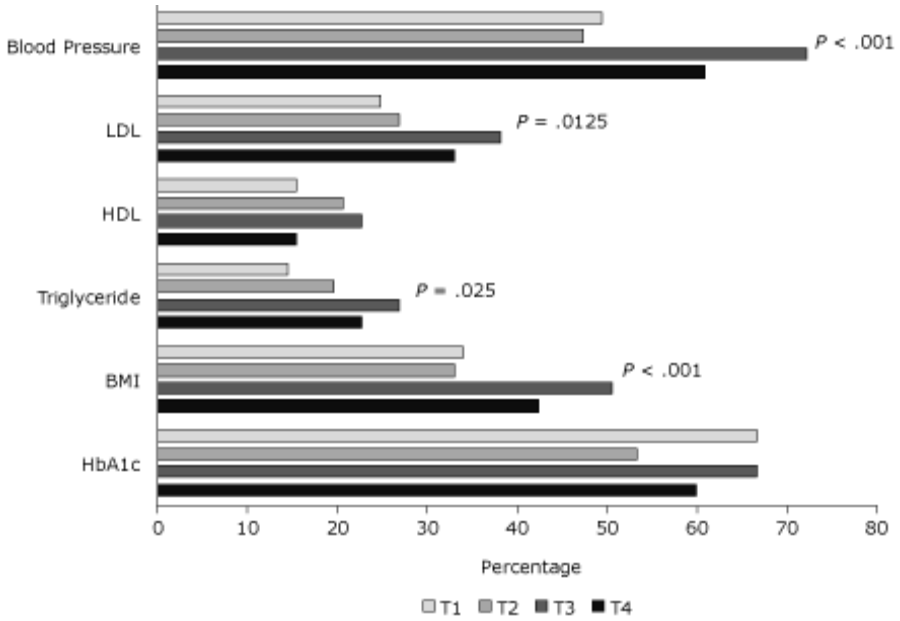

Figure. Percentage of patients attaining cardiovascular disease risk goals at selected observation windows of the Serious Mental Illness Primary Care Clinic (SMIPCC). Windows T1 and T2 were the 2 successive 6-month periods in the year before enrollment in SMIPCC, and T3 and T4 were the 2 successive 6-month periods of enrollment. *P* values represent significant differences between pre-enrollment and postenrollment in fully adjusted repeated measures logistic regression analyses. See Methods for descriptions of laboratory values that consitute goal attainment. Abbreviations: LDL, low-density lipoprotein; HDL, high-density lipoprotein; BMI, body mass index; HbA1c, hemoglobin A1c. [A tabular version of this figure is also available.]

Results of goal attainment analyses limited to T1 and T2 to test for temporal change in the period before enrollment were not significant, nor were findings for attainment of goals excluding subjects with missing values. Repeated-measures logistic regression analyses of only patients who had transferred usual primary care to SMIPCC showed that the adjusted models still had significant findings for blood pressure (AOR = 1.22; 95% CI, 1.15-2.50; *P* = .01), LDL cholesterol (AOR = 1.22; 95% CI, 1.01-2.18; *P* = .04), and BMI (AOR = 1.19; 95% CI, 1.26-2.51; *P* = .01). Among the 28 veterans with coronary artery disease, diabetes, or both, repeated measures logistic regression models showed enrollment was associated with a significant improvement in blood pressure goal attainment (AOR = 1.32; 95% CI, 1.22-3.60; *P* = .01) but not with the other measures.

Service use

Median number of primary care visits in the 6 months of observation before enrollment was 0, with an IQR of 1 (0-1) and overall range of 0 to 6. Median number of primary care visits in the 6-month observation window after enrollment was 2, with an IQR of 2 (1-3) and overall range of 0 to 12. Before enrollment, the median 6-month number of emergency department visits was 0, with an IQR of 1 (0-1) and overall range of 0 to 14; after enrollment the median 6-month number of emergency department visits was 0, with an IQR of 1 (0-1) and overall range of 0 to 6. Repeated-measures Poisson regression models showed that the number of primary care visits increased significantly after enrollment in SMIPCC (adjusted count = 3.4; 95% CI, 2.5-4.8; *P* < .001) compared with the number before enrollment, but the change in the number of emergency department visits was not significant.

In the observation window before enrollment, 49% of primary care visits with a provider were on the same day as any scheduled mental health visit, and this increased to 86% in the postenrollment observation window. Compared with the pre-enrollment period, repeated measures logistic regression analysis showed the odds of a primary care visit concurrent with a mental health visit was 7.13 (95% CI, 3.26-15.6; *P* < .001).

Discussion

Veterans with SMI had improved attainment of CVD risk factor goals after being enrolled in a primary care clinic co-located and integrated into the outpatient mental health clinic. Our findings are consistent with those of other reports in the literature regarding the benefits of co-location on quality of care and access (12). In the VA, the efficacy of a co-located, integrated primary care program in the mental health setting was demonstrated in a randomized controlled trial (11). Another study reported higher attainment of blood pressure and LDL cholesterol goals, but it compared the SMI population to the general population rather than examining change in these measures in the SMI population (14).

Outside the VA, medical care management for patients with SMI in community mental health centers has been effective (17), and researchers of this study observed a decrease in Framingham Risk Score among participants with laboratory values. However, Framingham Risk Score has been reported to be less reliable among patients with lower socioeconomic status (20), which may comprise a large portion of patients in community mental health centers. Our findings add to this body of work because, in data from a nonexperimental population examined before and after enrollment in the co-located clinic, we examined measurements of individual risk factors (blood pressure and fasting lipid panel in particular) rather than a composite score and demonstrated greater attainment of goals for these risk factors.

We observed a higher rate of primary care use, consistent with previous studies of this model of care. The rate of emergency department visits was not significant, but this finding may have been due to lack of power (the lower limit of the 95% CI was 0.91). Our findings regarding service use demonstrate the responsiveness of this model of care to patient need, particularly as the clinic is open access. Recent work has suggested that co-location of general medical services in the mental health setting reduces ambulatory care sensitive hospital admissions (21), which are potentially preventable with quality primary care delivery (22). The rate of hospitalizations was too low to examine in this study.

We note that the measured values did not change across the observation windows, and the measured values were generally good. This finding implies that the primary benefit from enrollment was in obtaining measurements in patients without prior measurements. Of note, 13% of the 97 patients enrolled in SMIPCC were new to primary care. Most patients had been enrolled in usual primary care previously, suggesting that the clinic effectively addressed low engagement in primary care, as intended. The VA considers missing performance measures as not at goal, so the finding of improvements in goal attainment is relevant from this perspective.

Patients with SMI may not receive optimal care because of organizational barriers and limited communication between their primary care and mental health providers (23). Drapalski et al found that 60% of veterans with SMI perceived barriers to access to medical care, and among the barriers, personal factors were the most common (24). We speculate that our clinic had a positive effect on control of CVD risk factors and service use because it addressed organizational and personal barriers to care by being convenient, patient-centered with open-access appointments, and linked to mental health service delivery. The co-location and linkage to mental health service delivery were key aspects to promoting integration, as was the proximity of primary care to mental health providers. Furthermore, the tandem nature of primary care and mental health visits promoted communication between primary care and mental health providers as well as between these providers and patients, which was evident in the concurrence between primary care and mental health visits in the postenrollment period.

Limitations of this study include constraints on the ability to generalize outside the VA and lack of an economic analysis. Our study was conducted at 1 site, so we cannot generalize beyond it. The VA health care system itself, as well as the population it serves, may be unique. We used a pre/post design, and therefore lack concurrent controls. However, examination of the 2 periods before enrollment showed no change at all, suggesting the effect we saw from pre- to postenrollment was attributable to the clinic rather than temporal trends. The cost-benefit of such a clinic would be valuable information, because a high-cost intervention would not be appealing, even if it were effective; such analysis is beyond the scope of the work we present here. However, previous work has reported that co-located, integrated programs are cost-neutral (11,12).

In summary, our primary care clinic for veterans with SMI that was co-located and integrated in the mental health setting improved attainment of CVD risk factor goals and increased primary care use. Our study demonstrated that the effects observed in efficacy studies of this model of care hold in a real-world clinic, supporting the concept that co-located, integrated primary care clinics can be implemented successfully in the mental health setting. Future studies of primary care for patients with SMI integrated into the mental health setting should determine best practices (ie, clinic structure, staffing, practices, and population management) and costs to better understand the facilitators and barriers to successful implementation.

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Tables

Table 1. Patient (N = 97) Demographic and Clinical Characteristics, Serious Mental Illness Primary Care Clinic, Providence, Rhode Island, 2008

Return

Characteristic[a]	n (%)[b]
Male sex	92 (95)
Non-Hispanic white race/ethnicity	83 (86)
VA service–connected disability >50%	40 (41)
Diabetes[c]	15 (15)
Dementia[c]	3 (3)
Liver disease, mild to moderate[c]	19 (20)
Liver disease, severe[c]	1 (1)
Renal disease[c]	6 (6)
Congestive heart failure[c]	7 (7)
Myocardial infarction[c]	4 (4)
Peripheral artery disease[c]	2 (2)
Stroke[c]	2 (2)
Chronic obstructive pulmonary disease[c]	12 (12)
Peptic ulcer disease[c]	7 (7)
Autoimmune connective tissue disease[c]	1 (1)
Cancer without metastasis[c]	14 (14)
Cancer with metastasis[c]	1 (1)
Hyperlipidemia	60 (62)
Hypertension	45 (46)
Coronary artery disease	15 (15)
Schizophrenia	23 (24)
Schizoaffective disorder	24 (25)
Psychosis, not otherwise specified	4 (4)
Bipolar disorder	14 (14)
Major depressive disorder	36 (37)
Alcohol abuse/dependence[d]	41 (42)
Substance abuse/dependence[d]	28 (29)

[a] Medical and psychiatric conditions are not mutually exclusive. VA service-connected disability refers to the VA's rating of degree of disability related to military service.
[b] Mean age was 55.3 y (standard deviation, 10.0 y).
[c] Denotes conditions used in the determination of the Charlson-Deyo Comorbidity Index.
[d] Alcohol and substance abuse/dependence includes both past and current.

Table 2. Cardiovascular Disease Risk Measurement Values in Each Observation Window,[a] Serious Mental Illness Primary Care Clinic, Providence, Rhode Island, 2008[b]

Return

Measure	T1		T2		T3		T4	
	n[c]	Mean (SD)	n[c]	Mean (SD)	n[c]	Mean (SD)	n[c]	Mean (SD)
SBP, mm Hg	61	125.2 (12.9)	59	122.3 (14.6)	95	125.4 (15.3)	71	125.2 (16.0)
DBP, mm Hg	61	75.5 (10.2)	59	73.6 (9.7)	95	76.4 (9.6)	71	74.9 (8.6)
LDLC, mg/dL	42	114.7 (34.8)	39	105.2 (36.1)	56	114.0 (31.5)	42	99.2 (33.9)
HDLC, mg/dL	42	40.8 (12.3)	38	41.9 (17.1)	56	41.9 (14.9)	42	40.9 (5.3)
TG, mg/dL	41	236.1 (187.6)	38	191.0 (200.7)	57	206.4 (165.8)	42	190.2 (134.6)
BMI, kg/m^2	69	30.8 (6.7)	65	30.3 (6.4)	96	30.2 (6.3)	77	29.6 (5.8)
HbA1c, %	11	7.1 (1.4)	9	7.2 (2.0)	10	6.7 (0.7)	10	6.8 (1.2)

Abbreviations: SD, standard deviation; SBP, systolic blood pressure; DBP, diastolic blood pressure; LDLC, low-density lipoprotein cholesterol; HDLC, high-density lipoprotein cholesterol; TG, triglycerides; BMI, body mass index; HbA1c, hemoglobin A1c.

[a] The T1 window was 12 to 6 months before enrollment; T2 was 6 months to enrollment; T3 was enrollment date to 6 months postenrollment; and T4 was 6 to 12 months postenrollment.

[b] No significant differences were found between observation windows.

[c] n = number of patients with observations.

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ORIGINAL RESEARCH

Clinical Characteristics, Comorbidities, and Response to Treatment of Veterans With Obstructive Sleep Apnea, Cincinnati Veterans Affairs Medical Center, 2005-2007

Pamela Samson, MS; Kenneth R. Casey, MD, MPH; James Knepler, MD; Ralph J. Panos, MD

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PEER REVIEWED

Abstract

Introduction
Obstructive sleep apnea (OSA) is a common disorder that is associated with significant morbidity. Veterans may be at an elevated risk for OSA because of increased prevalence of factors associated with the development and progression of OSA. The objective of this study was to determine the clinical characteristics, comorbidities, polysomnographic findings, and response to treatment of veterans with OSA.

Methods
We performed a retrospective chart review of 596 patients undergoing polysomnography at the Cincinnati Veterans Affairs Medical Center from February 2005 through December 2007. We assessed potential correlations of clinical data with polysomnography findings and response to treatment.

Results
Polysomnography demonstrated OSA in 76% of patients; 30% had mild OSA, 23% moderate OSA, and 47% severe OSA. Increasing body mass index, neck circumference, Epworth Sleepiness Scale score, hypertension, congestive heart failure, and type 2 diabetes correlated with increasing OSA severity. Positive airway pressure treatment was initiated in 81% of veterans with OSA, but only 59% reported good adherence to this treatment method. Of the patients reporting good adherence, a greater proportion of those with severe OSA (27%) than with mild or moderate disease (0%-12%) reported an excellent response to treatment.

Conclusion
The prevalence of metabolic and cardiovascular comorbidities increased with increasing OSA severity. Only 59% of treated patients reported good adherence to treatment with positive airway pressure, and response to treatment correlated with OSA severity.

Introduction

Obstructive sleep apnea (OSA), a condition characterized by repeatedly interrupted breathing during sleep, occurs frequently in adults (1). The prevalence of OSA increases with age and may affect 38% to 68% of people older than 60 years (1). Clinical characteristics that predict risk of development and progression of OSA include a large neck circumference and male sex. Body mass index (BMI) and tonsil size are predictors of OSA severity (2,3). Comorbid conditions associated with OSA include hypertension, atrial fibrillation, congestive heart failure, stroke, metabolic syndrome, and type 2 diabetes (2,4,5). Patients cared for by the Veterans Health Administration (VHA) are predominantly older men with many of these conditions (6). A survey of veterans in northeast Ohio using the Cleveland Sleep Habits questionnaire (7) showed that 46% of the respondents were at high risk for OSA (7). A similar study in San Juan, Puerto Rico, showed that 34% of veterans attending ambulatory clinics were at high risk for OSA (8).

OSA is diagnosed by polysomnography and measured by the apnea-hypopnea index (AHI). An AHI of more than 5 events per hour (9) is diagnosed as OSA. OSA severity is stratified according to AHI score. Fewer than 5 events per hour is designated as normal, 5 to 14 events per hour as mild OSA, 15 to 30 events per hour as moderate OSA, and more than 30 events per hour as severe OSA (9). Once OSA is diagnosed, a continuous positive airway pressure (CPAP) study is often performed to determine the optimal positive airway pressure required to reduce the AHI and improve oxygenation. The most common treatment for OSA, positive airway pressure (PAP) treatment, is frequently initiated to reduce sleep-related symptoms. Patients with more sleep-related symptoms appear to receive greater benefit from treatment than do patients with fewer sleep-related symptoms (10). Despite the availability of numerous types of masks and interfaces, CPAP is often poorly tolerated, and it is difficult to predict which patients will adhere and respond to treatment (11). The objective of this study was to determine the clinical characteristics, comorbidities, polysomnographic findings, and response to therapy of veterans with OSA.

Methods

We reviewed the records of 596 patients who underwent polysomnography during 3 years at the Cincinnati Veteran Affairs Medical Center (VAMC). Patients were evaluated on the basis of their AHI, OSA severity, clinical characteristics (eg, neck circumference, BMI), comorbidities, and response to treatment. This protocol was approved by the research and development committee of the Cincinnati VAMC and reviewed by the University of Cincinnati institutional review board, which waived the need for consent.

Participant selection

Health care providers throughout the Cincinnati VAMC referred veterans with suspected sleep disorders to our sleep clinic, where a standardized sleep evaluation was performed and polysomnography scheduled. We retrospectively reviewed the medical records and polysomnography reports of 748 veterans who completed evaluation and testing for sleep-disordered breathing in the Cincinnati VAMC from February 2005 through December 2007. From this chart review, we selected for our study group 596 patients who completed the evaluation and polysomnography testing. We excluded 152 patients with previously diagnosed OSA who returned for therapeutic (CPAP/bilevel titration) studies and patients who did not complete testing, terminated the test prematurely, or achieved insufficient or no sleep. All patients who were referred for polysomnography completed a pretest assessment and questionnaire with assistance from the sleep study technologist. Information abstracted from this questionnaire included age, measured weight, self-reported height, smoking history, Epworth Sleepiness Scale (ESS) score (a measure of sleep propensity) (12), and self-reported snoring, apneas, and morning headaches.

We used a Sandman Elite sleep system for polysomnography studies (Sandman Elite, version 8.0, Nellcor Puritan Bennett [Melville] Ltd, Kanata, Ontario, Canada). Monitored channels included bilateral oculograms, 4 electroencephologram channels, electrocardiogram, bilateral anterior tibialis electromyograms (EMG), chin EMG, body position, video channel, PAP level and flow, and snoring microphone. Nasal/oral and PAP airflow were measured by thermocouple, thoracic and abdominal respiratory effort by piezoelectric method, and oxygen saturation (SpO_2) by pulse oximetry. We analyzed and scored data according to criteria of the American Academy of Sleep Medicine (9). We defined apnea as cessation of airflow for at least 10 seconds and hypopnea as a reduction in airflow of at least 30% lasting at least 10 seconds, accompanied by at least a 4% decrease in oxygen saturation (9). Rapid eye movement (REM) rebound was defined as 20% or more of sleep time in REM. In many of our polysomnography studies we used a split-night protocol consisting of an initial diagnostic study followed by titration of CPAP or bilevel treatment on the same night. (CPAP maintains a constant minimal airway pressure throughout the respiratory cycle whereas bilevel treatment oscillates between a higher inspiratory pressure to maintain airway patency and a lower expiratory pressure to facilitate exhalation. Both are forms of positive airway pressure.) Patients with OSA who did not complete a split-night protocol because of an insufficient number of events, too little sleep, or too little REM sleep during the first half of the night returned for a titration study on another night.

Abstracted polysomnography data included total sleep time; sleep latency; REM latency; percentage of sleep achieved in stages 1, 2, 3-4, and REM; number of central, obstructive, and mixed apneas; number of hypopneas; REM-related AHI; and minimal SpO_2. If treatment was initiated, we reviewed these same values as well as AHI at optimal treatment pressure. We obtained patient medical history and information on comorbid conditions (ie, hypertension, coronary artery disease, congestive heart failure, atrial fibrillation, pulmonary hypertension, type 2 diabetes, cardiovascular accidents, and transient ischemic attacks) from the Cincinnati VAMC electronic medical record. We reviewed all clinical reports from postpolysomnography encounters to assess the patient's adherence to treatment and response to therapy. We graded adherence according to the following criteria: "good," patient reported use of positive pressure equipment for 3 or more nights weekly; "partial," patient reported use of equipment for fewer than 3 nights weekly; "not adherent," no use of equipment; and "not specified/no data," patient had not returned to the sleep clinic for follow-up or there were no comments regarding adherence in other clinical notes. For veterans with good adherence, we graded the response to treatment according to the following criteria: "excellent," complete or near complete relief of pretreatment sleep-related symptoms, greatly improved energy and alertness, and more restful sleep; "moderate,"

relief of most sleep-related symptoms but persistent daytime somnolence or fatigue and inconsistently restorative sleep; "no change," persistence of nearly all sleep-related symptoms; and "not specified/no data," patients had not returned to the sleep clinic for follow-up or there were no comments regarding sleep-disordered breathing in records of other clinical encounters.

Because of the high prevalence of severe OSA, we performed further comparisons to determine whether patients with ultrasevere OSA (AHI >60 events/h, 1 respiratory event/min) could be distinguished from those with less severe OSA (AHI 31-60 events/h).

Statistical analysis

We calculated mean, standard deviation (SD), standard error of the mean, and confidence intervals for continuous variables. Differences between the categorical OSA groups and continuous variables were analyzed by using 1-way ANOVA with the Bonferroni test for multiple comparisons. We calculated categorical variables as frequencies or proportions and analyzed them using χ^2 testing with the Marascuilo procedure for multiple comparisons. We defined significant differences as $P < .05$. We performed all statistical analyses with GraphPad Prism 5.0 statistical software (GraphPad, La Jolla, California).

Results

Patients were predominantly male (559 of 596 [94%]), with a mean (SD) age of 56.0 (11.6) years. Polysomnography demonstrated OSA in 76% of patients; 30% had mild OSA, 23% moderate OSA, and 47% severe OSA. Increasing BMI, neck circumference, ESS scores, hypertension, congestive heart failure, and type 2 diabetes correlated with increasing OSA severity (Table 1).

Among the OSA patients, the REM-related AHI rose and the SpO_2 declined as OSA severity increased (Table 2).

Treatment was initiated for 81% of the patients with OSA; 73% of patients received CPAP and 27% received bilevel therapy. With CPAP, the proportion of patients with REM rebound increased with increasing OSA severity; one-third of patients with severe OSA experienced REM rebound (Table 2). More than 10% of patients did not tolerate CPAP (pulled off the mask during the study or requested removal of the mask), and treatment adherence did not vary with OSA severity. The AHI declined dramatically with successful CPAP for all patients with OSA, and the posttreatment AHI was lower in the mild group compared with the severe group. The optimal levels of CPAP and inspiratory and expiratory bilevel pressures rose with increasing OSA severity.

Adherence and outcomes

Follow-up information about adherence to treatment was available for 291 of the 368 treated patients (79%). Of the 291, 172 patients (59%) reported using their CPAP or bilevel equipment at least 3 nights weekly, and 27 of 100 (27%) patients with severe OSA reported an excellent response compared with 0 of 40 patients with mild OSA (Table 3).

Ultrasevere and less severe OSA

Patients with more than 30 AHI events per hour (n = 211) were divided into less severe (n = 99) and ultrasevere (n = 112) categories. More patients with ultrasevere OSA reported a history of observed apnea events, a higher BMI, and concurrent coronary artery disease and pulmonary hypertension than did patients with less severe OSA. Although the minimal SpO_2 was less in the ultrasevere group, other polysomnographic findings, treatments, adherence, and outcomes were similar in the 2 groups.

Discussion

In our study group of 596 patients who underwent complete diagnostic polysomnography testing, 76% had OSA. Of these, 30% had mild, 23% moderate, and 47% severe OSA. BMI, neck circumference, and ESS score increased with worsening OSA severity, as did cardiovascular and metabolic comorbidities. Most patients were treated for OSA, but only 59% reported good adherence with positive pressure therapy. More adherent patients with severe OSA than with mild or moderate disease reported an excellent response to treatment. Finally, despite a higher proportion of patients with severe OSA, we were unable to determine clinical or polysomnographic features that distinguished less severe OSA from ultrasevere OSA.

Previous studies within the VHA have shown that 34% to 47% of veterans attending outpatient clinics are at increased risk for OSA (7,8). In 1983, a preliminary study of 27 randomly selected inpatients at the San Diego VAMC who underwent portable polysomnography monitoring of 4 channels (thoracic and abdominal respiratory effort, lower-extremity electromyogram, and wrist actigraphy) in their hospital beds demonstrated that 7 (27%) had sleep apnea, defined as 30 or more apneas per hour (13). Subsequent studies at the same institution using the same study protocol found that 84% of 436 randomly selected inpatients had an AHI greater than 5 in 1991, and 53% of 186 inpatients had

an AHI greater than 15 in 2003 (14,15). In contrast, a review of the first 117 patients undergoing polysomnography by the same group in the San Diego Sleep Disorders Clinic showed that 44% had sleep apnea (16). Approximately one-fourth (46 of 192) of Persian Gulf War veterans self-referred to the Comprehensive Clinical Evaluation Program at Fort Sam Houston had histories suggesting a sleep disorder; polysomnography demonstrated OSA (defined as a respiratory disturbance index of ≥15 events/h) in 33% of these veterans (17). Differences in technology, study protocols including the tested population, and definition of OSA make it difficult to compare these reports with our study, which demonstrated OSA (AHI ≥5 events/h) in 76% of veterans undergoing polysomnography, 47% of whom had severe OSA (AHI >30 events/h).

Based on previous estimates of the proportion of the veteran population that is at increased risk of OSA (34%-47%) (7,8) and our polysomnography results (76% with demonstrated OSA, 47% of whom had severe OSA), approximately 26% to 36% of veterans served by the VHA would be diagnosed with OSA, and 12% to 17% would have severe OSA if all veterans at increased risk for sleep disordered breathing completed diagnostic polysomnography testing. In a review of VHA administrative databases from 1998 to 2001, Sharafkhaneh and colleagues (18) found that the prevalence of coded and documented diagnosed OSA was 2.9%. Thus, sleep apnea may be underrecognized and underdiagnosed in veterans receiving care in the VHA system, and possibly only 1 of every 5 to 10 veterans with OSA is diagnosed. Prospective, multicenter epidemiologic studies are needed to determine the precise prevalence and severity of OSA among veterans served by the VHA.

Previous population-based studies suggest that 15% to 32% of men in the general American population have OSA and that the prevalence of severe OSA is approximately 5% (1). These prevalence calculations are very similar to our estimated prevalence of OSA and severe OSA in the national veteran population, 26% to 36% and 12% to 17%, respectively. These national studies include people aged 20 to 99 and, since the prevalence of OSA appears to begin to increase with age in midlife, may not be comparable to the national veteran population (1). Furthermore, the veteran population may have a higher prevalence of factors associated with the development and progression of OSA, such as excess body weight, smoking, alcohol consumption, and nasal congestion (1). Thus, comparison of the veteran population with an age-, sex-, and risk-factor–matched cohort from the general American population is required to determine whether the prevalence and severity of OSA are the same in both groups.

In our study, BMI, neck circumference, and ESS score correlated positively with AHI. Participants in the Sleep Heart Health Study (SHHS) who had an AHI of 15 or more were significantly more likely to have an increased BMI, neck circumference, and breathing-pause frequency (2). The SHHS did find a correlation between habitual snoring and loud snoring and AHI of 15 or more, which we did not see in our study (2). Of all the patient attributes evaluated in the SHHS, self-reported, frequent apneas (>3 nights/wk) occurred most frequently among those with an AHI of 15 or more (49%), but this finding alone was only minimally predictive of OSA (2). BMI and neck circumference are strong predictors of OSA, whereas self-reported apneas, ESS values, and frequent, loud snoring predict OSA severity (2,19).

In 118,105 veterans diagnosed with OSA, metabolic and cardiovascular comorbidities occurred frequently: diabetes in 32.9%, obesity in 30.5%, hypertension in 60.1%, cardiovascular disease in 27.6%, congestive heart failure in 13.5%, and cerebrovascular accident in 5.7% (17). In our study, the prevalence of hypertension, congestive heart failure, and type 2 diabetes correlated with OSA severity. Large studies have shown a positive association between hypertension and OSA severity (1,20). In a study of nearly 2,300 people in China undergoing polysomnography, AHI was linearly related to systolic and diastolic blood pressure up to an AHI of 60 (19). Others have also shown that the prevalence of diabetes increases with the severity of OSA (21).

The minimal measured SpO_2 declined with increasing OSA severity. Various indices of nocturnal oxygen saturation have been shown to correlate with and predict AHI (22,23). Lin and colleagues (23) showed that the oxyhemoglobin desaturation index was the most sensitive and specific measure of oxygenation for all levels of OSA.

For many patients, apneas and hypopneas can be more prominent during REM sleep (24). A Japanese study found that patients with an AHI of 60 or more were significantly more likely to have a higher AHI in non-REM sleep than in REM sleep, whereas among patients with less severe disease, the relationship was reversed (25). Another investigation showed that half of patients with OSA have a higher non-REM AHI than REM AHI (26). The REM-related AHI correlated with AHI and increased most dramatically when AHI was greater than 60 events per hour.

Our study showed that patients with severe OSA were slightly more likely to adhere to CPAP treatment, a finding similar to that of other investigations (27,28). In our study, 53% of patients with severe OSA had good adherence to treatment, whereas only 39% of those with mild OSA reported using their equipment more than 3 nights weekly. Adherence to CPAP use is better in people with more daytime sleepiness regardless of OSA severity (10,29). The ESS score, a measure of excessive daytime sleepiness, was significantly higher in patients with more severe OSA, suggesting that these patients were more symptomatic and may have experienced more symptom improvement with treatment. The higher proportion of excellent response to treatment among Cincinnati VMAC patients with severe OSA corresponds to results of previous studies that found significant associations between the resolution of symptoms with

CPAP treatment and improved treatment adherence (30,31).

This study was a retrospective review of polysomnography studies at a single center, the Cincinnati VAMC sleep center. Patients with more severe sleep-related symptoms may have been preferentially referred for sleep evaluation, resulting in higher prevalence and severity of OSA. Only completed diagnostic polysomnography studies were analyzed; including patients who did not complete testing and may not have had OSA would reduce the OSA diagnosis rate. In most of the patients we studied, we used a split-night polysomnography protocol that may have underestimated the presence and severity of OSA. Another limitation was the use of self-reporting for adherence assessment. Although patients' CPAP and bilevel units were examined for the numbers of hours used per night, this evaluation was not performed consistently, and there were insufficient data for analysis. Finally, the severity of hypertension and treatment for hypertension at the time of the polysomnography study were not documented. Only the presence or absence of a hypertension diagnosis was noted.

On the basis of our data and on previous surveys of the prevalence of patients at high risk for OSA within the VHA, we estimate the prevalence of OSA to be 26% to 36% of veterans cared for by the VHA, and the prevalence of severe OSA to be 12% to 17%. Metabolic and cardiovascular comorbidities occurred frequently in veterans with OSA, and the prevalence of these disorders increased with OSA severity. Only 59% of treated patients at the Cincinnati VAMC reported good adherence with CPAP treatment, and within this group, response to therapy increased as OSA severity worsened.

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Tables

Table 1. Clinical Characteristics of Veterans (N = 596) With Obstructive Sleep Apnea, Cincinnati Veterans Affairs Medical Center, 2005-2007

Return

	Obstructive Sleep Apnea Severity[a]				
	None	Mild		Severe	

Characteristic	(n = 144)	(n = 136)	Moderate (n = 105)	(n = 211)	*P* Value[b]
Age, mean (SD), y	54.0 (13.1)	55.6 (11.9)	56.9 (9.4)	57.1 (11.3)	.07
Male sex, n (%)	124 (86.1)	128 (94.1)	101 (96.2)	206 (97.6)	<.001[c]
Health history					
Morning headaches, n (%)	52 (38.9)	52 (30.4)	41 (44.6)	75 (39.7)	.69
Epworth Sleepiness Scale[d], mean (SD)	11.5 (5.7)	12.2 (5.1)	11.7 (5.8)	14.0 (5.4)	<.001[e]
Self-reported snoring, n (%) (n = 535)[f]	122 (99.0)	122 (100)	93 (98.9)	192 (98.0)	.19
Self-reported apneas, n (%) (n = 413)[f]	78 (87.6)	86 (95.5)	71 (87.6)	153 (93.9)	.09
Physical examination					
BMI, mean (SD), kg/m^2	31.3 (5.8)	34.7 (7.2)	35.9 (7.4)	37.4 (8.5)	<.001[e]
Neck circumference, mean (SD), in	16.9 (1.6)	17.9 (1.7)	17.7 (1.8)	18.1 (1.6)	<.001[e]
Comorbidities					
Hypertension, n (%)	89 (61.8)	106 (77.9)	81 (77.1)	172 (81.5)	<.001[c]
Coronary artery disease, n (%)	34 (23.6)	36 (26.5)	27 (25.7)	55 (26.1)	.38
Congestive heart failure, n (%)	13 (9.0)	14 (10.3)	6 (5.7)	33 (15.6)	.04
Atrial fibrillation, n (%)	5 (3.5)	9 (6.6)	5 (4.8)	10 (4.7)	.82
Pulmonary hypertension, n (%)	3 (2.1)	6 (4.4)	3 (2.9)	6 (2.8)	.40
Type 2 diabetes, n (%)	33 (22.9)	69 (50.7)	44 (41.9)	98 (46.4)	<.001[g]
Cardiovascular accidents, n (%)	9 (6.3)	7 (5.1)	5 (4.8)	15 (7.1)	.43
Transient ischemic attacks, n (%)	1 (0.1)	3 (2.2)	0	2 (0.9)	.67
Smoking history					
Current smoker, n (%)	54 (37.5)	30 (22.0)	39 (37.1)	62 (29.3)	.02
Never smoked, n (%)	20 (13.9)	24 (17.6)	20 (19.0)	46 (21.8)	.09

Abbreviation: SD, standard deviation; BMI, body mass index.
[a] None, apnea-hypopnea index (AHI) <5; mild, AHI 5-14; moderate, AHI 15-30; severe, AHI >30.
[b] ANOVA with Bonferonni correction was used to compare continuous values and χ^2 test with Marasculio procedure was used to compare proportional variables.
[c] None vs severe.
[d] Johns (12).
[e] None vs severe, mild vs severe, moderate vs severe.
[f] Data were not available for all patients; n = number of patients with this information.
[g] None vs mild, moderate, and severe.

Table 2. Polysomnographic Findings and Treatment of Patients With Obstructive Sleep Apnea (N = 596), Cincinnati Veterans Affairs Medical Center, 2005-2007

Return

Findings/Treatment	Obstructive Sleep Apnea Severity[a]				*P* Value[b]
	None (n = 144)	Mild (n = 136)	Moderate (n = 105)	Severe (n = 211)	
Polysomnographic findings					
Pretreatment AHI, mean (SD), events/h	1.5 (1.9)	9.2 (2.9)	21.3 (4.3)	66.9 (27.5)	NA
Pretreatment REM-related AHI, mean (SD),	5.5 (13.2)	29.7	44.0 (32)	54.1	<.001[c]

events/h		(22.9)		(34.5)	
Minimum SpO_2, mean (SD), %	88.4 (4.5)	83.4 (6.3)	81.9 (8.1)	78.4 (9.3)	<.001[d]
Treatment					
Patients receiving CPAP treatment, n (%)	NA[e]	82 (60.3)	56 (53.3)	129 (61.1)	.60
CPAP pressure, mean (SD), cm H_2O	NA[e]	8.2 (2.3)	8.3 (1.9)	9.9 (2.5)	<.001[d]
Patients receiving bilevel treatment, n (%)	NA[e]	21 (15.4)	21 (20.0)	59 (28.0)	.02[f]
Bilevel pressure inspiration, mean (SD), cm H_2O	NA[e]	12.0 (2.5)	13.3 (2.7)	14.5(3.2)	.002[f]
Bilevel pressure expiration, mean (SD), cm H_2O	NA[e]	7.8 (2.5)	9.2 (2.6)	10.2 (3.0)	.003[f]
Did not tolerate CPAP or bilevel treatment, n (%)	NA[e]	13 (9.6)	17 (16.2)	17 (8.0)	.08
REM rebound, n (%) (n = 435)[g]	NA[e]	12 (8.8)	21 (20.0)	64 (33.0)	<.001[f]
Posttreatment AHI, mean (SD), events/h	NA[e]	3.0 (5.1)	3.6 (4.7)	5.6 (9.5)	.04[f]

Abbreviations: AHI, apnea-hypopnea index; SD, standard deviation; NA, not applicable; REM, rapid eye movement; SpO_2, pulse oximetry oxygen saturation; CPAP, continuous positive airway pressure.
[a] None, AHI <5; mild, AHI 5-14; moderate, AHI 15-30; severe, AHI >30.
[b] ANOVA with Bonferonni correction was used to compare continuous values, and χ^2 test with Marasculio procedure was used to compare proportional variables.
[c] Mild vs moderate and severe.
[d] Mild vs severe, moderate vs severe.
[e] Treatment data are only for patients with OSA.
[f] Mild vs severe.
[g] REM rebound was defined as 20% of sleep time in REM; no. is the number of patients with data concerning REM rebound. Data were not available for all patients; n = number of patients with this information.

Table 3. Adherence of Patients With Obstructive Sleep Apnea (n = 368) Treated With Positive Airway Pressure and Response in Patients with Good Adherence to Treatment (n = 172), Cincinnati Veterans Affairs Medical Center, 2005-2007

Return

Adherence/Response	Obstructive Sleep Apnea Severity,[a] n %			*P* Value[b]
	Mild (n = 103)	Moderate (n = 77)	Severe (n = 188)	
Adherence[c]				
Good	40 (39)	32 (42)	100 (53)	.09
Partial	20 (19)	12 (16)	21 (11)	
Not adherent	18 (17)	12 (16)	36 (19)	
Not specified/no data	25 (24)	21 (27)	31 (16)	
Response[d]				
Excellent	0	4 (12)	27 (27)	.01[e]
Moderate	25 (62)	17 (53)	49 (49)	
No change	1 (2)	0	2 (2)	
Not specified/no data	14 (35)	11 (34)	22 (22)	

[a] None, AHI <5; mild, AHI 5-14; moderate, AHI 15-30; severe, AHI >30.
[b] χ^2 test with Marasculio procedure was used to compare proportional variables.
[c] Good, self-reported use of positive pressure equipment for ≥3 nights weekly; partial, self-reported use of equipment <3 nights weekly; not adherent, no use of equipment; not specified/no data, patient did not return to the sleep clinic for follow-

up or there were no comments regarding adherence in other clinical notes.
[d] Excellent, complete or near complete relief of pretreatment sleep-related symptoms, greatly improved energy and alertness, and more restful sleep; moderate, relief of most sleep-related symptoms but persistent daytime somnolence or fatigue and inconsistently restorative sleep; no change, persistence of nearly all sleep-related symptoms; not specified/no data, patients did not return to the sleep clinic for follow-up or there were no comments regarding sleep disordered breathing in other clinical notes.
[e] Mild vs severe.

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ORIGINAL RESEARCH

Prevalence and Risk of Homelessness Among US Veterans

Jamison Fargo, PhD, MS; Stephen Metraux, PhD; Thomas Byrne, MSW; Ellen Munley; Ann Elizabeth Montgomery, PhD; Harlan Jones; George Sheldon, PhD; Vincent Kane, MSW; Dennis Culhane, PhD

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PEER REVIEWED

Abstract

Introduction

Understanding the prevalence of and risk for homelessness among veterans is prerequisite to preventing and ending homelessness among this population. Homeless veterans are at higher risk for chronic disease; understanding the dynamics of homelessness among veterans can contribute to our understanding of their health needs.

Methods

We obtained data on demographic characteristics and veteran status for 130,554 homeless people from 7 jurisdictions that provide homelessness services, and for the population living in poverty and the general population from the American Community Survey for those same jurisdictions. We calculated prevalence of veterans in the homeless, poverty, and general populations, and risk ratios (RR) for veteran status in these populations. Risk for homelessness, as a function of demographic characteristics and veteran status, was estimated by using multivariate regression models.

Results

Veterans were overrepresented in the homeless population, compared with both the general and poverty populations, among both men (RR, 1.3 and 2.1, respectively) and women (RR, 2.1 and 3.0, respectively). Veteran status and black race significantly increased the risk for homelessness for both men and women. Men in the 45- to 54-year-old age group and women in the 18- to 29-year-old age group were at higher risk compared with other ages.

Conclusion

Our findings confirm previous research associating veteran status with higher risk for homelessness and imply that there will be specific health needs among the aging homeless population. This study is a basis for understanding variation in rates of, and risks for, homelessness in general population groups, and inclusion of health data from US Department of Veterans Affairs records can extend these results to identifying links between homelessness and health risks.

Introduction

Veterans are overrepresented among the homeless in the United States and are at greater risk than nonveterans of becoming homeless (1-10). Homelessness is associated with chronic health conditions, either causing or preceding such conditions, becoming a consequence of such conditions, or complicating the treatment and care of such conditions (11-14). Furthermore, among the 136,000 homeless veterans in 2009, 53% had a chronic health condition (15). Understanding the epidemiology of homelessness and the specific factors associated with increased risk of becoming homeless is prerequisite to both reducing homelessness and more effectively addressing the health needs of this population.

The objective of this study was to provide a more detailed assessment of risk for homelessness among veterans than

has been previously reported, in comparison with the nonveteran population and after controlling for various demographic characteristics. Specifically, we sought to answer 2 research questions: 1) Is veteran status associated with an increased risk of homelessness? and 2) Does risk of homelessness among veterans vary as a function of age, race, and sex?

Methods

Study design

Homeless Management Information Systems (HMIS) and American Community Survey (ACS) data from 7 jurisdictions provided a basis for estimating the prevalence of veterans in the homeless, poverty, and overall populations; calculating risk ratios for veteran status in the homeless population compared with veteran status in the poverty and overall populations; determining if veteran status is associated with an increased risk of homelessness; and identifying whether risk of homelessness among veterans varies as a function of age, race, or sex.

Data collection

Data for this study came from the 2008 HMIS and the 2006-2008 ACS. Service providers use HMIS to record data on client characteristics and use of services in homeless populations across a local area known as a continuum of care (CoC). A CoC is a planning entity established by the US Department of Housing and Urban Development (HUD) for a geographic unit, which can range in size from a large city to multiple rural counties. In a CoC, stakeholders and service providers coordinate resources and provide services (eg, shelter, housing, food) to address homelessness (16). The more than 400 CoCs throughout the United States are each mandated by HUD to maintain an HMIS that collects data on the local service-using homeless population. The data fields collected include identifying information, veteran status, demographics, the presence of disabling conditions, and dates of program entry and exit.

A convenience sample of 11 urban CoCs from geographic regions throughout the country initially provided HMIS data for this study. These HMIS datasets consisted of unduplicated, de-identified, individual records for adults who used emergency shelter or transitional housing within their CoC during 2008. HMIS data from 7 of these 11 jurisdictions were usable and sufficiently complete (<10% missing): New York, New York; San Jose/Santa Clara County, California; Columbus/Franklin County, Ohio; Denver, Colorado (Denver, Adams, Arapahoe, Boulder, Broomfield, Douglas, and Jefferson counties); Tampa/Hillsborough County, Florida; Phoenix/Maricopa County, Arizona; and Lansing/Ingham County, Michigan.

We estimated data missing because of nonresponse to an item in the dataset (17) (ie, missing 1 or more data elements) from these CoCs by using single imputation techniques and SOLAS version 3.2 (Statistical Solutions, Saugus, Massachusetts). Some users of homeless services were not included in HMIS data because of the service providers' lack of participation; this unit nonresponse was addressed by applying a variation of the extrapolation procedures used in the Annual Homeless Assessment Report (AHAR) to estimate additional homeless people (veterans and nonveterans) who used homeless services but were not recorded doing so (18). Extrapolation procedures produce reliable estimates when more than half of providers in a CoC participate in HMIS (ie, <50% data missing because of unit nonresponse); all CoCs included in this study were well above this threshold. Extrapolation increased our homeless sample by 20,964 people (2,455 veterans, 18,509 nonveterans), a 16% increase over the original sample.

To compute rates of homelessness, we used ACS data to estimate the total veteran and nonveteran populations in each CoC. The ACS is an annual survey administered by the US Census Bureau that collects social, economic, and demographic information from samples of housing units in all counties in the United States (19). We selected 3-year estimates (2006-2008) for this study because they are based on a larger sample size than the 1-year estimates and offer better precision, especially in examining smaller populations such as veterans, and smaller geographic areas. When CoC boundaries varied from the geographic areas for which ACS estimates are publicly available, the US Census Bureau provided customized ACS estimates for these CoCs. For each geographic area, we aggregated ACS data by age, sex, race, veteran status, and poverty status.

This study received approval as an exempt study from institutional review boards at the University of Pennsylvania and the US Department of Veterans Affairs (VA).

Outcomes

Homelessness status was our outcome of interest. Data collected through HMIS for the homeless population included age (18-29, 30-44, 45-54, 55-64, >65 y), race (black, nonblack), sex, and veteran status (veteran, nonveteran). ACS variables included in this study were age, race, sex, and veteran status in categories consistent with HMIS data. In addition, ACS data were stratified by poverty status, that is, whether household income was below the federal poverty threshold. All people in the HMIS database were considered as living in poverty on the basis of their homeless status. ACS, which collects data from group quarters in addition to private housing units, included both homeless and housed members of the population but did not differentiate the population on this basis. Veteran status is defined as having

served in the US military and is based on self-report in both HMIS and ACS data.

Data analysis

Two phases of analysis used pooled data from the 7 CoCs. All analyses were weighted by CoC size, were conducted separately for men and women as well as for the total population and for the population living in poverty (from the ACS), and were conducted using the R language and environment for statistical computing, version 2.13 (R Foundation for Statistical Computing, Vienna, Austria) (20).

In the first phase, we estimated the prevalence of veterans in the homeless, poverty, and overall populations and calculated corresponding risk ratios (RR). This process provided a simple measure of whether veterans were overrepresented in the homeless population. We computed prevalence and risk ratios for each age, race, and sex subgroup. Risk ratios for men and women were age- and race-adjusted.

In the second phase, we conducted binomial generalized estimating equation (GEE) analyses in which homeless status was the outcome, and age, race, and veteran status were potential predictors. Because we were modeling frequencies, the outcome was a ratio of homeless (from HMIS data) to total (general or poverty population from ACS data) people for each subpopulation, as defined by the frequency within each subgroup, weighted by that same frequency (21). GEE modeling adjusted for dependence because of clustering within individual CoCs. The phase 2 analysis consisted of main-effects-only multivariate models. Three interaction effects were selected *a priori* and tested but were later discarded because they were found to be nonsignificant: veteran status by 1) age, 2) race, and 3) age by race.

Results

Phase 1 results

An estimated 130,554 adults received homelessness services in the 7 CoCs in this study; 10,726 of these adults (8.2%) reported veteran status (Table 1). This rate was higher than the veteran rate among the ACS poverty (n = 63,655, 3.34%) and ACS general (n = 1,023,515, 6.96%) populations. Compared with nonveterans, veterans in each population (HMIS, ACS poverty, ACS general) were disproportionately male and in the older age categories.

Veterans were overrepresented in the homeless population for both sexes (Table 2). For men, 13.6% of the homeless adults were veterans, whereas for women 1.8% of homeless adults were veterans. These rates yielded age- and race-adjusted RRs of 2.1 (men) and 3.0 (women) compared with the population living in poverty, and 1.3 (men) and 2.1 (women) compared with the general population. RRs for demographic subgroups were generally consistent with the overall RRs.

The age- and race-adjusted RRs for homelessness among both men and women were higher for veterans than for nonveterans in both the poverty (RR, 2.2 for men and 3.0 for women) and general populations (RR, 1.4 for men and 2.3 for women) (Table 3). Rates of homelessness were consistently higher in veteran populations than in nonveteran populations, and among both veterans and nonveterans, black adults, especially in the younger age groups, had higher rates of homelessness.

Phase 2 results

Veteran status, older age, and black race were significantly and independently associated with risk of homelessness among both men and women. Similarly, the patterns of results found in the general population were consistent with those found in the poverty population; however, in the latter, veteran status was associated with a greater risk for homelessness.

For the veteran indicator, male veterans were almost 50% as likely (adjusted odds ratio [AOR], 1.47; 95% confidence interval [CI], 1.19-1.81) and female veterans were almost twice as likely (AOR, 1.97; 95% CI, 1.25-3.12) to be homeless as nonveterans in the general population. Among the population in poverty, male veterans were more than twice as likely (AOR, 2.20; 95% CI, 1.96-2.48) and female veterans were more than 3 times as likely (AOR, 3.33; 95% CI, 2.17-5.13) to be homeless as nonveterans.

Among the control variables, increased age was significantly associated with homelessness, but its effect differed between sexes. Among men, risk for homelessness generally increased as a function of age up to the 45- to 54-year-old age range, but declined thereafter. This was so among both veterans and nonveterans and in both the general and poverty populations. Men in the 45- to 54-year-old age group appeared to be at the highest risk of homelessness, nearly twice as likely (AOR, 1.85; 95% CI, 1.18-1.93) in the general population and 3 times as likely (AOR, 2.65; 95% CI, 1.41-4.97) in the poverty population as their 18- to 29-year-old counterparts to be homeless. Male veterans in the 45- to 54-year-old age group made up 41% of the homeless veterans. Risk for homelessness among women declined with age at an increasing rate in both the general and poverty populations, so that older women were at the lowest risk for homelessness, compared with the youngest group.

Finally, black race was also a significant predictor of homelessness among all subgroups. In the general population, the risk associated with black race increased more than 5-fold for both men and women (AOR, 5.49; 95% CI, 4.25-7.09 for men and AOR, 5.45; 95% CI, 4.23-7.01 for women). This risk was lower in the poverty population but remained high; the AOR for men was 2.18 (95% CI, 1.95-2.45) and for women was 3.32 (95% CI, 2.16-5.11).

Discussion

The findings in this report support those of earlier studies that showed veterans to be overrepresented in the homeless population and reach beyond by showing veteran status to be associated with increased risk for homelessness after controlling for race, sex, and age. The magnitude of this association became greater after controlling for poverty; veteran status was associated with more than a 2-fold increase for men and a 3-fold increase for women in the odds of becoming homeless.

For male veterans, those in the 45- to 54-year-old age group made up 41% of the homeless veterans and also had the highest risk for becoming homeless. This finding is consistent with other research (2) that identified a cohort effect in this age group of veterans. This cohort, whose key characteristic was service during the initial years of the All Volunteer Force, instituted in 1973, has continuously been the veteran age group at highest risk for homelessness as these veterans have aged over the last 2 decades. Similarly, members of the general population who are now aged 45 to 54 have continuously been at highest risk for homelessness (21-23).

Veterans make up a discrete subgroup in this general age cohort, in terms of both the increased risk for homelessness associated with their veteran status and their access to health care and homeless services through the VA. The susceptibility of homeless people to chronic disease and disability increases as they age, and the veterans among them will increasingly turn to the VA for health care. Given their lack of housing and heightened susceptibility to chronic health problems, homeless veterans will likely contribute disproportionately to the increased demand for long-term care through the VA (24). But beyond that, the changing health and need for housing support services of an aging homeless population are poorly understood. As the VA responds to an aging veteran population through increased reliance on community-based care to treat chronic illness (25), those with the most tenuous ties to the community will be the ones who present the most pressing challenges.

Among women, particularly black women, the youngest age groups were at highest risk for homelessness. This finding is consistent with media accounts that women who served in more recent conflicts such as those in Iraq and Afghanistan are more likely than older female veterans to be homeless (26). This finding is also consistent with other research indicating that among women in general, the period of highest vulnerability for homelessness is during the time period when they are heading families with young children (27). Because younger cohorts are most at risk, female veterans stand to benefit more from existing homelessness-prevention efforts tied to reentering civilian life, which focus on housing needs, than from efforts that combine housing with health care services.

Veterans who are living in poverty are more vulnerable to homelessness, an effect that is magnified by black race. For example, for the youngest age group living in poverty, more than 50% of black male veterans and more than 30% of black female veterans were homeless (compared with only 7% for nonblack males and 12% for nonblack females), according to HMIS data. These alarmingly high rates suggest that homelessness-prevention activities—including tenant/landlord mediation or short-term rent and utility payments—among veterans may be particularly effective because they can target a finite poverty population and can further refine this effort by focusing on black veterans. Our findings highlight the usefulness of these data for such targeting, but future investigations of risk factors must go beyond the simple focus on race and poverty status. The addition of health-related data to the datasets used here could make specific links between health conditions and risk for homelessness. The VA is currently building a registry of veterans using homelessness services that can be linked to VA health care records, which promises such assessments of health-related risks for homelessness and for which this study could be a prototype.

Although the 7 CoCs included in our study represented approximately 10% of the US homeless population, they are a convenience sample of urban jurisdictions, which limits our study's comparability to other studies. This difference likely contributed to the divergence in a key finding between this study and the Veteran Supplement to the Annual Homelessness Assessment Report (15). Whereas this study demonstrated that male veterans were overrepresented among the homeless population (RR, 1.3), the Vet-AHAR found them to be underrepresented (RR, 0.7). This disparity is explained in part by the differences in geographic areas, as the Vet-AHAR was a nationally representative estimate. Further explanation for this difference in findings is the Vet-AHAR's inability to adjust its risk assessments by age and race.

Another limitation of our study is that the veteran status was based on self-report and likely included people who reported veteran status but may have been ineligible for VA services. Conversely, we may have included people eligible for VA services who did not acknowledge veteran status. The HMIS data are also limited in their universally available data fields, and a more comprehensive range of data fields would go further toward understanding and eliminating

homelessness.

In conclusion, this study offers evidence that supports and expands on prior findings that veterans, particularly older veterans, are vulnerable to homelessness. As more and richer data on veteran homelessness, and homelessness in general, become available through HMIS and other administrative sources, future research should be able to increasingly relate health data to the demographic characteristics included in this study.

Acknowledgments

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Tables

Table 1. Demographic and Geographic Characteristics of Homeless People in Selected US Metropolitan Areas[a]

Return

Characteristic	HMIS Homeless Population[b] (n = 130,554)		ACS Poverty Population[c] (n = 1,905,110)		ACS General Population[d] (n = 14,708,440)	
	Veteran, % (n = 10,726)	Nonveteran, % (n = 119,828)	Veteran, % (n = 63,655)	Nonveteran, % (n = 1,841,455)	Veteran, % (n = 1,023,515)	Nonveteran, % (n =13,684,925)
Age, y						
<29	6.8	32.4	6.2	33.6	4.3	24.9
30-44	24.0	38.5	14.2	28.1	15.3	31.3
45-54	40.8	21.0	20.0	14.5	15.0	18.5
55-64	23.3	6.7	25.5	10.2	25.4	12.5
≥65	5.1	1.4	34.1	13.7	40.1	12.9
Sex						
Female	10.2	48.9	9.8	60.2	6.8	54.8
Male	89.8	51.1	90.2	39.8	93.2	45.2
Race						
Black	46.0	46.9	21.2	19.4	11.4	13.9
Nonblack	54.0	53.1	79.8	80.6	88.6	86.1
CoC metropolitan area						
Columbus, Ohio	6.4	4.4	7.2	6.1	7.5	5.6

Denver, Colorado	7.6	3.3	16.3	10.6	19.5	13.5
Lansing, Michigan	2.4	1.7	2.0	2.0	1.6	1.5
New York City	36.5	62.2	35.4	54.8	24.5	45.7
Phoenix, Arizona	20.2	12.3	24.9	16.1	29.2	18.7
San Jose, California	17.5	12.0	5.9	5.3	7.6	9.2
Tampa, Florida	9.3	4.1	8.3	5.1	10.1	5.8

Abbreviations: HMIS, Homeless Management Information System; ACS, American Community Survey; CoC, Continuum of Care.
[a] Source: CoC data are collected for geographic units established by the US Department of Housing and Urban Development to track resource use for homeless populations.
[b] People within a CoC who used homelessness services, according to HMIS 2008.
[c] Adults identified by the ACS 2006-2008 whose incomes fell below the federal poverty threshold.
[d] ACS, 2006-2008.

Table 2. Prevalence and Risk of Veteran Status in Homeless, Poverty, and Overall Populations in 7 US Metropolitan Areas[a]

Return

Characteristic		Veterans in Homeless Population[b], % (n = 10,726)		Veterans in Poverty Population[c], % (n = 63,655)		RR[d]		Veterans in General Population[e], % (n = 1,023,515)		RR[f]	
Age, y	Race	M	F	M	F	M	F	M	F	M	F
18-29	Black	3.8	1.0	0.9	0.4	4.2	2.2	1.9	0.6	2.0	1.7
	Nonblack	2.7	1.0	1.3	0.3	2.2	3.1	2.1	0.5	1.3	2.0
30-44	Black	8.2	3.2	5.9	1.3	1.4	2.5	7.3	1.6	1.1	1.9
	Nonblack	7.6	1.3	3.5	0.4	2.1	2.9	5.9	0.8	1.3	1.6
45-54	Black	21.0	2.7	14.7	1.0	1.4	2.6	14.7	1.7	1.4	1.6
	Nonblack	19.6	3.1	9.2	1.1	2.1	2.9	9.8	1.2	2.0	2.5
55-64	Black	31.9	1.8	20.8	0.8	1.5	2.3	23.0	0.9	1.4	1.9
	Nonblack	30.6	3.1	19.0	0.6	1.6	4.9	27.6	1.0	1.1	3.1
≥65	Black	32.3	1.4	26.7	0.5	1.2	2.9	33.2	0.6	1.0	2.6
	Nonblack	33.7	2.4	21.9	0.9	1.5	2.8	45.4	1.1	0.7	2.1
All ages[g]	Black	13.7	2.0	9.4	0.8	2.4	2.5	11.8	1.1	1.4	1.9
	Nonblack	13.4	1.6	7.4	0.6	2.0	3.1	13.6	0.9	1.3	2.1
All ages[h]	All races	13.6	1.8	7.8	0.6	2.1	3.0	13.4	0.9	1.3	2.1

Abbreviations: M, male; F, female; RR, risk ratio.
[a] Continuum of Care (CoC) data are collected for geographic units established by the US Department of Housing and Urban Development to track resource use for homeless populations. The 7 CoC metropolitan areas included in this analysis are Columbus, Ohio; Denver, Colorado; Lansing, Michigan; New York City; Phoenix, Arizona; San Jose, California; and Tampa, Florida.
[b] People within a CoC who used homelessness services, according to Homeless Management Information System 2008.
[c] Adults whose incomes fell below the federal poverty threshold, according to the American Community Survey (ACS) 2006-2008.
[d] Prevalence of veterans in homeless population divided by prevalence of veterans in poverty population.
[e] ACS 2006-2008.

Prevalence of veterans in homeless population divided by prevalence of adults in general population.
[g] Risk ratios are age-adjusted.
[h] Risk ratios are both age- and race-adjusted.

Table 3. Prevalence and Risk of Homelessness[a] Among Veterans and Nonveterans in Poverty and General Populations in 7 US Metropolitan Areas[b]

Return

Characteristic		Homelessness Among Veterans in Poverty Population[c], %		Homelessness Among Nonveterans in Poverty Population[c], %		RR[d]		Homelessness Among Veterans in General Population[e], %		Homelessness Among Nonveterans in General Population[e], %		RR[f]	
Age, y	Race	M	F	M	F	M	F	M	F	M	F	M	F
18-29	Black	52.8	36.3	11.8	15.7	4.5	2.3	5.4	7.9	2.6	4.6	2.1	1.7
	Nonblack	7.3	11.9	3.3	3.9	2.2	3.1	0.7	1.6	0.5	0.8	1.4	2.1
30-44	Black	33.8	35.4	23.7	13.8	1.4	2.6	4.7	6.3	4.1	3.2	1.1	2.0
	Nonblack	17.2	12.1	7.7	4.4	2.2	2.8	1.0	0.9	0.7	0.6	1.3	1.5
45-54	Black	38.0	29.1	24.6	10.7	1.5	2.7	7.3	3.2	4.8	2.0	1.5	1.6
	Nonblack	21.0	12.3	8.7	4.1	2.4	3.0	1.9	1.1	0.9	0.4	2.2	2.7
55-64	Black	24.2	9.1	13.6	3.7	1.8	2.4	3.8	1.4	2.4	0.7	1.6	2.1
	Nonblack	10.5	9.3	5.6	1.8	1.9	5.2	0.6	0.6	0.6	0.2	1.1	3.3
≥65	Black	4.8	1.7	3.6	0.6	1.3	2.8	0.6	0.4	0.6	0.1	1.0	3.2
	Nonblack	2.1	0.8	1.2	0.3	1.8	2.9	0.1	0.1	0.1	0.0	0.7	2.3
All ages[g]	Black	26.8	29.7	17.7	11.6	2.5	2.5	4.0	4.9	3.4	2.7	1.5	2.1
	Nonblack	10.6	9.2	5.5	3.3	2.2	3.2	0.6	0.8	0.7	0.5	1.4	2.3
All ages[h]	All races	14.6	15.0	7.9	5.1	2.2	3.0	1.0	1.6	1.0	0.8	1.4	2.3

Abbreviations: M, male; F, female; RR, risk ratio.
[a] People within a Continuum of Care (CoC) who used homelessness services, according to Homeless Management Information System 2008.
[b] CoC data are collected for geographic units established by the US Department of Housing and Urban Development to track resource use for homeless populations. The 7 CoC metropolitan areas included in this analysis are Columbus, Ohio; Denver, Colorado; Lansing, Michigan; New York, New York; Phoenix, Arizona; San Jose, California; and Tampa, Florida.
[c] People whose incomes fell below the federal poverty threshold, according to the American Community Survey (ACS) 2006-2008.
[d] Prevalence of homelessness among veterans divided by prevalence of homelessness among nonveterans in poverty population.
[e] ACS 2006-2008.
[f] Prevalence of homelessness among veterans divided by prevalence of homelessness among nonveterans in the general population.
[g] Risk ratios are age-adjusted.
[h] Risk ratios are both age- and race-adjusted.

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ORIGINAL RESEARCH

Dietary Calcium and Risk for Prostate Cancer: A Case-Control Study Among US Veterans

Christina D. Williams, PhD, MPH; Brian M. Whitley, MD; Cathrine Hoyo, PhD, MPH; Delores J. Grant, PhD; Gary G. Schwartz, PhD; Joseph C. Presti, Jr, MD; Jared D. Iraggi; Kathryn A. Newman; Leah Gerber; Loretta A. Taylor; Madeline G. McKeever; Stephen J. Freedland, MD

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PEER REVIEWED

Abstract

Introduction
The objective of this study was to examine the association between calcium intake and prostate cancer risk. We hypothesized that calcium intake would be positively associated with lower risk for prostate cancer.

Methods
We used data from a case-control study conducted among veterans between 2007 and 2010 at the Durham Veterans Affairs Medical Center. The study consisted of 108 biopsy-positive prostate cancer cases, 161 biopsy-negative controls, and 237 healthy controls. We also determined whether these associations differed for blacks and whites or for low-grade (Gleason score <7) and high-grade prostate cancer (Gleason score ≥7). We administered the Harvard food frequency questionnaire to assess diet and estimate calcium intake. We used logistic regression models to obtain odds ratios (ORs) and 95% confidence intervals (CIs).

Results
Intake of calcium from food was inversely related to risk for prostate cancer among all races in a comparison of cases and biopsy-negative controls (P = .05) and cases and healthy controls (P = .02). Total calcium was associated with lower prostate cancer risk among black men but not among white men in analyses of healthy controls. The highest tertile of calcium from food was associated with lower risk for high-grade prostate cancer in a comparison of high-grade cases and biopsy-negative controls (OR, 0.37; 95% CI, 0.15-0.90) and high-grade cases and healthy controls (OR, 0.38; 95% CI, 0.17-0.86).

Conclusion
Calcium from food is associated with lower risk for prostate cancer, particularly among black men, and lower risk for high-grade prostate cancer among all men.

Introduction

In the Veterans Health Administration (VHA), there are approximately 12,000 incident cases of prostate cancer each year (LL Zullig, MPH, Durham VA Medical Center, unpublished data, March 2011). Environmental factors such as diet are thought to influence prostate cancer development and progression. Data on the effects of calcium intake on prostate cancer are inconsistent. Some epidemiologic studies provide evidence of a positive association (1-5), while others report no association (6-8). Nearly all of these studies were performed in populations made up predominantly of white men, even though associations between modifiable risk factors such as calcium intake and prostate cancer risk may differ by race.

A potential mechanism for the role of calcium in prostate cancer development and progression is that intracellular calcium controls the growth of prostate cancer cells and the process of apoptosis (9). Calcium may also have an indirect effect; it has been hypothesized that dietary calcium may increase prostate cancer risk by reducing circulating levels of

1,25-dihydroxyvitamin D (1,25[OH]$_2$D) (10), which promotes the differentiation and inhibits the proliferation of prostate cells (11). Therefore, a high calcium intake would counteract the potentially anticarcinogenic effects of vitamin D and thereby promote tumor growth.

The objective of this study was to examine the relationship between calcium intake and prostate cancer risk and determine whether this association is different for blacks and whites or for low-grade and high-grade disease. We hypothesized that calcium would be positively associated with prostate cancer risk.

Methods

Study design

We used data from an ongoing case-control study of veterans screened for prostate cancer at the Durham Veterans Affairs Medical Center (DVAMC) in Durham, North Carolina. Details of this case-control study have been reported previously (12). This study was approved by the institutional review board at the DVAMC, and all patients provided written informed consent.

Study participants

This study includes participants enrolled between January 2007 and September 2010 who were aged at least 18 years, had a prostate-specific antigen (PSA) screening test done within 12 months prior to enrollment, and had no prior history of prostate cancer. We identified men from the urology clinic at the DVAMC who were scheduled for a prostate biopsy because of an elevated PSA or abnormal rectal examination. Of the 785 men scheduled for a biopsy and screened for eligibility, 577 provided written consent to participate. Among participants who received the biopsy (n = 533), 216 were biopsy-positive and considered cases for this study; 316 were biopsy-negative and served as biopsy-negative controls. After we assessed eligibility by medical record review and obtained physicians' permission to contact patients, we recruited 393 healthy control participants (ie, no biopsy indication) from the urology and internal medicine clinics during routine visits. We required completion of study questionnaires for inclusion in the final analytic sample. Meeting this requirement were 50% of biopsy-positive cases, 51% of biopsy-negative controls, and 60% of healthy controls. Thus, the final sample consisted of 108 biopsy-positive cases, 161 biopsy-negative controls, and 237 healthy controls.

Data collection

We collected diet and covariate data using self-administered questionnaires. We used the Harvard food frequency questionnaire (FFQ) for data on diet (13). Participants recalled their usual consumption of 61 foods and beverages in the previous 12 months. This FFQ has been tested for validity and found to be a good assessment of nutrient intake during a 1-year period (13). The FFQ also solicited information on dietary supplement use, including the frequency and dose of single supplements and multivitamins. Nutrient intakes were derived from the frequency, amount, and nutrient content of each food, beverage, and supplement on the FFQ. The Harvard School of Public Health conducted the nutrient analysis. We used a separate questionnaire to obtain information on potential prostate cancer risk factors, including smoking and alcohol use, physical activity, and family history of prostate cancer. To minimize differential recall bias due to biopsy results, we asked patients to complete questionnaires before the biopsy. The Gleason scores were based on standard reviews of biopsy specimens by a board-certified pathologist and were part of standard care. We abstracted Gleason scores and race information from the medical record. Trained personnel measured height and weight.

Statistical analysis

We performed all analyses using SAS version 9.2 (SAS Institute, Inc, Cary, North Carolina). We examined total calcium intake (food plus supplements) and calcium from food only. We compared cases and controls by using a χ^2 test for categorical variables and the Wilcoxon rank sum test for continuous variables. Calcium intake was adjusted for total calories using the nutrient residual method (14) and categorized into tertiles based on the distribution in the respective control population. Data from FFQs are useful for ranking nutrient intake; categorizing nutrient intake makes no assumption about the dose-response relationship between calcium and prostate cancer risk. We chose tertile categories because of the range of calcium intake in our study population. We examined tertiles separately for total calcium and tertiles for calcium from food only. We determined odds ratios (ORs) and corresponding 95% confidence intervals (CIs) through logistic regression to estimate relative risk for prostate cancer; we used the lowest tertile as the reference group. We modeled separately the risk for prostate cancer by using healthy controls and biopsy-negative controls. We examined the potential for effect modification by race in stratified analyses. We also entered a cross-product term in the models along with the main-effects terms to test for calcium-race interaction; we evaluated the coefficient of the cross-product term by using the Wald χ^2 test. We used multinomial logistic regression to determine whether the association between calcium and prostate cancer varied by disease aggressiveness. These analyses compared the risk for low-grade prostate cancer (Gleason score <7, n = 60) relative to controls and the risk for high-grade (ie, aggressive) prostate cancer (Gleason score ≥7, n = 48) relative to controls. We adjusted all models for age (continuous), total

calories (continuous), and race (white, black, other). Analyses with biopsy-negative controls were further adjusted for log-transformed PSA. We considered other potential confounders, including body mass index (BMI, kg/m^2), family history of prostate cancer, smoking status, alcohol use, and vitamin D intake. These covariates did not appreciably alter our results and therefore were not included in the final models. We assessed linear trends in risk by incorporating into the models a continuous variable assigned the median nutrient intake for each tertile. *P* values less than .05 were considered statistically significant.

Results

Cases and controls did not differ significantly by age, education, family history, smoking status, alcohol use, prevalence of supplement or vitamin use, or intakes of calcium or calories (Table 1). Compared with biopsy-negative controls, cases reported significantly less physical activity. Of cases, 56% of were black; of healthy controls, 35% were black. Healthy controls had a slightly higher mean BMI than cases (31 vs 29). The mean total calcium intake among our study participants was approximately 800 mg per day. Among biopsy-negative controls, the mean calcium intake (total and from food only) in blacks was significantly lower than in whites, and black healthy controls reported significantly less calcium from food than did white healthy controls (Table 2).

In a comparison of cases and biopsy-negative controls among all races, increasing calcium intakes from food but not total calcium was associated with lower risk for prostate cancer (*P* = .05) (Table 3). We found a significant interaction between race and total calcium (*P* = .04), which suggested that higher total calcium was linked with higher cancer risk in whites but lower risk in blacks, but we found no significant risk estimates in race-specific analyses (Table 3).

In a comparison of cases and healthy controls among all races, a larger intake of calcium from food but not total calcium was associated with lower risk for prostate cancer (Table 3). In race-specific analyses, total calcium was associated with lower prostate cancer risk among black men but not among white men. We found no statistically significant associations among whites. The interaction between total calcium and race was not significant (*P* = .07).

We found a moderate correlation between calcium and vitamin D (Spearman $\rho = 0.59$, $P < .001$ in healthy controls; Spearman $\rho = 0.46$, $P < .001$ in biopsy-negative controls); adjustment for vitamin D intake did not alter results.

We observed no associations between calcium intake (total or from foods only) and low-grade prostate cancer (Table 4). In a comparison of cases and biopsy-negative controls, the highest tertile of calcium from food was associated with lower risk for high-grade cancer. In a comparison of cases and healthy controls, the highest tertile of total calcium and of calcium from food was associated with lower risk for high-grade cancer.

Discussion

We found little evidence to support a positive association between calcium intake and prostate cancer risk in this case-control study. On the contrary, we found no association between total calcium and prostate cancer risk and an inverse association between calcium from food and risk for prostate cancer among all men. An inverse association between total calcium and prostate cancer was limited to black men in analyses using healthy controls, although no evidence of an association was found among white men. Also, a high calcium intake correlated with lower risk for high-grade cancer but not low-grade cancer.

One meta-analysis reported that prospective cohort studies suggest a weak positive association between the highest and lowest category of calcium intake and prostate cancer risk and that case-control studies indicate no association (15). Theoretically, higher calcium intakes could increase prostate cancer risk by reducing the biologically active form of vitamin D, which can inhibit prostate cancer cell growth (16). This theory may explain, in part, the positive association between prostate cancer risk and high levels of calcium intake. Two prospective studies, for example, observed an elevated risk for prostate cancer for a calcium intake of 2,000 mg per day or more (1,17). The mean total calcium intake among our study participants was relatively low, approximately 800 mg per day. According to the US Department of Agriculture, an adequate calcium intake is 1,000 mg per day for men aged 51 to 70 years and 1,200 mg per day for men aged 70 or older (18). On the basis of these guidelines, only 27% of our study population had adequate calcium intake, so we did not have sufficient variation to test whether extremely high intakes (ie, ≥2,000 mg/d) correlated with prostate cancer risk. Our results suggest that among men with low to moderate calcium intake, an adequate calcium intake (ie, 1,000 mg/d) may reduce the risk for prostate cancer. Viewed alternatively, our study suggests that very low calcium intake may increase prostate cancer risk relative to adequate intake. Coupled with the data that high calcium intake may increase prostate cancer risk, our study supports the notion that most nutrients, particularly micronutrients and specifically calcium, may have a J-shaped or U-shaped relationship with disease, whereby deficiencies and excesses correlate with higher risk and adequate intakes correlate with lower risk (19).

In our study, calcium supplements contributed approximately 100 mg per day to total calcium in each participant group. Although total calcium intake may be a more informative measure than calcium intake from food only, we observed in analyses of all races inverse associations between prostate cancer and calcium from food but not total

calcium. This finding suggests that calcium intake from supplements may not reduce prostate cancer risk as supplement users may expect and that adequate calcium from food sources alone may be sufficient to reduce prostate cancer risk. However, a level of supplemental calcium that could reduce prostate cancer risk and a level that could increase risk should be identified.

Few studies have examined whether associations between calcium and prostate cancer risk differ by race/ethnicity. Skin pigmentation has a strong effect on vitamin D status; people with darker skin have more melanin, which reduces the ability to synthesize vitamin D from sunlight radiation (20). As a result, blacks are more prone to vitamin D deficiency and reduced levels of calcium absorption (21). Our finding that blacks have lower calcium intake compared with whites is consistent with the literature (8,22). Our results further suggest that calcium intake affects prostate cancer risk differentially by race. The limited number of studies that have considered this possibility found no clear association between dietary calcium and prostate cancer risk among whites or blacks (8,23). One study, however, reported a correlation between an increase in dairy consumption and a higher risk for prostate cancer among whites but not blacks (23). In the same study, ORs for quartiles of calcium intake from food were less than 1 among blacks (P = .06) and greater than 1 among whites (P = .22), although ORs were not statistically significant (23). Our results also suggest an inverse association between calcium intake and prostate cancer risk among black men but not white men. These results may reflect the lower (but not significantly lower) caloric intake among blacks compared with whites, despite our attempt to control for total calories. Given that most studies of calcium and prostate cancer risk have included samples made up largely of white men (2,3,17,24) and that we show a difference in the effect of calcium on prostate cancer risk between black and white men, future studies are needed to validate our findings and understand the biological mechanisms responsible for our observations.

Dietary factors may impose different risks for subgroups of prostate cancers. Our results are consistent with the lack of an association between calcium and low-grade prostate cancer (8,25). In contrast to previous reports of null (8,24) and positive (25) associations with high-grade prostate cancer, we found an inverse association between high-grade prostate cancer and dietary calcium. Another study also noted lower risk for high-grade prostate cancer (defined as Gleason score 8-10) among men in the Prostate Cancer Prevention Trial who had a high calcium intake (26). Given the inverse association between calcium intake and prostate cancer risk we observed among black men, we considered the possibility that high-grade prostate cancer was more common in black case patients compared with white case patients and thus responsible for the inverse relationship between calcium intake and high-grade prostate cancer. However, in our study population, 44% of black men and 50% of white men with prostate cancer had high-grade prostate cancer. Again, our finding may imply that adequate calcium intake (ie, 1,000 mg/d) among people with a low- to moderate-calcium diet could reduce the risk for high-grade prostate cancer. We were unable to test the notion that a very high calcium intake may contribute to prostate cancer progression because our sample included few men who had a very high calcium intake.

This study had several limitations. The FFQ may not have included all foods necessary for accurately assessing intake, especially fortified foods and foods unique to certain geographic locations or racial/ethnic groups. This study had biases common to case-control studies. Nonresponse bias may have resulted from the large portion of participants who did not complete the study questionnaires and were excluded from analyses; thus, we cannot exclude the possibility that participants who completed the study questionnaires differed from those who did not. The FFQ required participants to recall their intake in the previous 12 months, which is likely not the etiologically relevant period of exposure, though the exact etiologically relevant time is not known. Recall bias could have been different for cases and controls. We attempted to minimize recall bias by interviewing men before their biopsy and biopsy results. Selection bias was minimized by recruiting all participants from a population of veterans screened for prostate cancer at the DVAMC, but bias is possible if some participants had previous biopsies or an elevated PSA or both. Our sample was small, resulting in limited statistical power and variation in nutrient intakes. Our study was based on data from veterans screened for prostate cancer and receiving care in the VA system, the largest health care system in the United States and an equal-access setting; therefore, generalizability of our findings to non-VA populations is uncertain. The major strength of our study is that the population of veterans at the DVAMC is particularly useful for examining racial disparities because of the equal-access health system and the large proportion of blacks receiving care at the DVAMC.

We observed lower risk for prostate cancer with increasing intakes of calcium from food in both healthy and biopsy-negative controls. The inverse association between total calcium and prostate cancer was limited to black men. Among all men, the highest calcium intake in our study was related to lower risk for high-grade prostate cancer but was not associated with low-grade prostate cancer. Overall, our findings suggest that among men with diets that have moderate to low calcium intake, adequate calcium intake may reduce the risk for prostate cancer, particularly among black men, and reduce the risk for high-grade prostate cancer among all men. Because of the numerous benefits of calcium in preventing chronic diseases, more research is needed to clarify its role in prostate health. In particular, researchers should determine the levels at which dietary calcium may increase the risk for prostate cancer and examine whether the effect of calcium on prostate cancer risk differs by race/ethnicity.

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Tables

Table 1. Participant Characteristics by Case-Control Status Among Veterans Screened for Prostate Cancer at Durham Veterans Affairs Medical Center, 2007-2010

Return

Characteristic	Cases (n = 108)	Biopsy-Negative Controls (n = 161)	Healthy Controls (n = 237)	*P* Value[a]	*P* Value[b]
Age, mean (SD), y	63 (5.6)	63 (5.9)	62 (7.6)	.74	.12
Race, no. (%)					
Black	60 (56)	66 (41)	82 (35)	.15	.007
White	47 (43)	89 (55)	148 (62)		
Other	1 (1)	2 (1)	4 (2)		
Missing	0	4 (3)	3 (1)		
≥College degree, no. (%)	32 (30)	46 (29)	66 (28)	.90	.25
BMI, mean (SD), kg/m^2	29 (5.3)	30 (5.2)	31 (5.2)	.38	.02
Physical activity, mean (SD), MET h/wk	12 (26)	21 (50.6)	10 (17)	.02	.70
Family history of prostate cancer, no. (%)	22 (20)	29 (18)	33 (14)	.63	.13
Current smokers, no. (%)	36 (33)	34 (21)	56 (24)	.06	.06

Current drinkers, no. (%)	54 (50)	64 (40)	98 (41)	.23	.30
PSA, median, ng/mL	5.95	5.1	0.8	.001	<.001
Use of calcium supplements, no. (%)	13 (12)	17 (11)	37 (16)	.66	.40
Use of multivitamins, no. (%)	43 (40)	62 (38)	101 (43)	.71	.65
Intake, mean (SD)					
Total calories, kcal/d	2,098 (1,197)	1,879 (876)	1,811 (819)	.40	.14
Total calcium, mg/d	797 (473)	797 (478)	825 (512)	.90	.73
Calcium from food, mg/d	690 (413)	706 (408)	692 (399)	.52	.79

Abbreviations: SD, standard deviation; BMI, body mass index; MET, metabolic equivalents; PSA, prostate-specific antigen.
[a] Indicates difference between cases and biopsy-negative controls; calculated by using χ^2 test for categorical variables and Wilcoxon rank sum test for continuous variables.
[b] Indicates difference between cases and healthy controls; calculated by using χ^2 test for categorical variables and Wilcoxon rank sum test for continuous variables.

Table 2. Calcium and Vitamin D Intakes and Supplement Use Among Controls, by Race, Among Veterans Screened for Prostate Cancer at Durham Veterans Affairs Medical Center, 2007-2010

Return

Intake	Biopsy-Negative Controls			Healthy Controls		
	Blacks (n = 66)	Whites (n = 89)	*P* Value[a]	Blacks (n = 82)	Whites (n = 148)	*P* Value[a]
Total calcium, mean (SD), mg/d	677 (380)	873 (508)	.02	732 (452)	880 (540)	.06
Calcium from food, mean (SD), mg/d	619 (368)	759 (405)	.04	639 (420)	722 (383)	.04
Use calcium supplements, %	10	11	.82	16	18	.76
Use multivitamins, %	32	47	.06	47	44	.65
Total calories, mean (SD), kcal/d	1,821 (961)	1,908 (787)	.36	1,726 (931)	1,877 (757)	.07

Abbreviation: SD, standard deviation.
[a] Calculated by using χ^2 test for categorical variables and Wilcoxon rank sum test for continuous variables.

Table 3. Dietary Calcium Intake and Risk for Prostate Cancer Among Veterans Screened for Prostate Cancer at Durham Veterans Affairs Medical Center, 2007-2010

Return

Cases vs Biopsy-Negative Controls						
	All Races[a] (n = 269)		Black (n = 126)		White (n = 136)	
Median Intake	No. of Cases	OR (95% CI)[b]	No. of Cases	OR (95% CI)[b]	No. of Cases	OR (95% CI)[b]
Total calcium, mg/d						
Tertile 1[c]: 376.8	48	1 [Reference]	37	1 [Reference]	11	1 [Reference]
Tertile 2: 704.7	28	0.85 (0.45-1.63)	10	0.43 (0.17-1.11)	17	1.73 (0.54-4.58)

Tertile 3: 1,174.8	32	0.85 (0.45-1.61)	13	0.53 (0.21-1.34)	19	1.70 (0.66-4.41)
P value for linear trend[d]		.66		.17		.37
Calcium from food, mg/d						
Tertile 1[c]: 367.3	43	1 [Reference]	28	1 [Reference]	15	1 [Reference]
Tertile 2: 597.3	44	1.28 (0.70-2.37)	22	1.03 (0.43-2.43)	21	1.58 (0.65-3.86)
Tertile 3: 1,093.8	21	0.54 (0.27-1.05)	10	0.53 (0.20-1.43)	11	0.61 (0.23-1.60)
P value for linear trend[d]		.05		.22		.22
Cases vs Healthy Controls						
	All Races[a] (n = 345)		**Black (n = 142)**		**White (n = 195)**	
Median Intake	**No. of Cases**	**OR (95% CI)[b]**	**No. of Cases**	**OR (95% CI)[b]**	**No. of Cases**	**OR (95% CI)[b]**
Total calcium, mg/d						
Tertile 1[e]: 390.6	50	1 [Reference]	39	1 [Reference]	11	1 [Reference]
Tertile 2: 707.5	29	0.67 (0.37-1.21)	8	0.25 (0.10-0.67)	20	1.61 (0.69-3.78)
Tertile 3: 1,245.9	29	0.60 (0.33-1.08)	13	0.39 (0.16-0.95)	16	1.14 (0.47-2.76)
P value for linear trend[d]		.11		.04		.98
Calcium from food, mg/d						
Tertile 1[e]: 346.4	54	1 [Reference]	37	1 [Reference]	17	1 [Reference]
Tertile 2: 602.2	31	0.72 (0.40-1.29)	13	0.48 (0.20-1.15)	17	0.92 (0.41-2.11)
Tertile 3: 1,054.5	23	0.50 (0.27-0.91)	10	0.42 (0.17-1.05)	13	0.63 (0.27-1.46)
P value for linear trend[d]		.02		.06		.27

Abbreviations: OR, odds ratio; CI, confidence interval.
[a] Includes black, white, and other races (n = 7).
[b] Adjusted for age, total calories, race (in combined analyses), and prostate-specific antigen (in analyses of prostate cancer cases vs biopsy-negative controls).
[c] We created categories of calcium intake based on tertiles of intake among biopsy-negative controls.
[d] *P* values for linear trend were based on the median intake of each tertile, which was subsequently modeled as a continuous variable.
[e] We created categories of calcium intake based on tertiles of intake among healthy controls.

Table 4. Dietary Calcium Intake and Risk for Low-Grade and High-Grade Prostate Cancer Among Veterans Screened for Prostate Cancer at Durham Veterans Affairs Medical Center, 2007-2010

Return

	Low-Grade Prostate Cancer vs Biopsy-Negative Controls		**High-Grade Prostate Cancer vs Biopsy-Negative Controls**	
Median Intake	**No. of Cases**	**OR (95% CI)[a]**	**No. of Cases**	**OR (95% CI)[a]**
Total calcium, mg/d[b]				

Tertile 1[c]: 376.8	21	1 [Reference]	27	1 [Reference]
Tertile 2: 704.7	19	1.39 (0.64-3.05)	9	0.41 (0.16-1.03)
Tertile 3: 1,174.8	20	1.27 (0.59-2.72)	12	0.46 (0.20-1.09)
P value for linear trend[d]		.62		.11
Calcium from food, mg/d				
Tertile 1[c]: 367.3	18	1 [Reference]	25	1 [Reference]
Tertile 2: 597.3	30	2.25 (1.06-4.76)	14	0.60 (0.26-1.37)
Tertile 3: 1,093.8	12	0.74 (0.31-1.73)	9	0.37 (0.15-0.90)
P value for linear trend[d]		.33		.02
	Low-Grade Prostate Cancer vs Healthy Controls		**High-Grade Prostate Cancer vs Healthy Controls**	
Median Intake	**No. of Cases**	**OR (95% CI)[a]**	**No. of Cases**	**OR (95% CI)[a]**
Total calcium, mg/d[b]				
Tertile 1[e]: 390.6	23	1 [Reference]	27	1 [Reference]
Tertile 2: 707.5	20	1.11 (0.54-2.28)	9	0.34 (0.14-0.80)
Tertile 3: 1,245.9	17	0.83 (0.40-1.73)	12	0.40 (0.18-0.90)
P value for linear trend[d]		.56		.04
Calcium from food, mg/d				
Tertile 1[e]: 346.4	25	1 [Reference]	29	1 [Reference]
Tertile 2: 602.2	22	1.24 (0.61-2.52)	9	0.33 (0.14-0.79)
Tertile 3: 1,054.5	13	0.63 (0.29-1.36)	10	0.38 (0.17-0.86)
P value for linear trend[d]		.21		.02

Abbreviations: OR, odds ratio; CI, confidence interval.
[a] Adjusted for age, total calories, race, and prostate-specific antigen (in analyses of prostate cancer cases vs biopsy-negative controls).
[b] Total dietary calcium intake includes calcium from food and from supplements.
[c] We created categories of calcium intake based on tertiles of intake among biopsy-negative controls.
[d] *P* values for linear trend were based on the median intake of each tertile, which was subsequently modeled as a continuous variable.
[e] We created categories of calcium intake based on tertiles of intake among healthy controls.

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PREVENTING CHRONIC DISEASE
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ESSAY

Preventing Chronic Illness in Young Veterans by Promoting Healthful Behaviors

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Since October 2001, more than 2 million Americans have served in the US wars in Afghanistan and Iraq, and nearly half of these veterans have been deployed more than once (1). Most are adults younger than age 35 when they return home from service. Upon return, veterans can choose to remain active, be inactive while serving in a component such as the Reserves or National Guard, or be separated from service. In the general population, the transition from adolescence to young adulthood is a time of increased risk for behavioral chronic disease risk factors such as excess weight gain and tobacco use escalation. However, few studies have examined the health behaviors of young veterans, and, perhaps as a result, few programs, interventions, and policies are designed to promote healthful behaviors for recently returned veterans. There are a variety of reasons as to why veterans are at increased risk for chronic disease risk behavior. We will also highlight opportunities to develop innovative strategies to promote healthful behaviors among veterans of the wars in Iraq and Afghanistan.

Gaps in Our Understanding of Tobacco-Use and Weight-Related Behaviors Among Young Veterans

Three modifiable behaviors — tobacco use, physical inactivity, and poor diet — caused one-third of all deaths in the United States in 2000 (2,3). Promoting tobacco-free lifestyles and healthful weight-related behaviors is important in the veteran population, which appears to be at increased risk for some of these behaviors (4,5).

The prevalence of tobacco use among veterans of the wars in Iraq and Afghanistan is high. In 2008, nearly one-third of active duty military personnel reported smoking in the past month, and 14% reported smokeless tobacco use (6); meanwhile, just under 20% of the adult US population were reported to be current smokers (7), and approximately 3% of the US population older than aged 12 years reportedly used smokeless tobacco (8). Although military service has long been associated with tobacco use, the prevalence of tobacco use among Iraq and Afghanistan war veterans appears to be exceedingly high; they are 50% more likely to use tobacco than their military peers who did not deploy (4). Some never smokers and most former smokers who deploy to Iraq and Afghanistan initiate or resume smoking (5). A complex array of factors that include sociocultural background, personality traits that may be more common to people who join the military, combat exposure, military culture, reintegration challenges, military career path, alcohol abuse, and emotional or mental health issues likely underlies this high prevalence of tobacco use, which has also been observed in prior conflicts (4,5).

For the general population, emerging adulthood is a time of increased risk for excess weight gain (9), and the prevalence of obesity among young adults aged 20 to 39 years is high; more than one-fourth of young adults are obese (body mass index [BMI] >30 kg/m^2) (10). Data on obesity rates in Afghanistan and Iraq war veterans are limited. Iraq and Afghanistan war veterans in a US Department of Veterans Affairs (VA) sample were more likely to be overweight but less likely to be obese compared with national same-age samples (11). In a large military cohort study, nearly half of participants experienced “extreme weight gain” (≥10% of their weight) from the first wave of data collection (2001-2003) through the second wave (2004-2006), a period of time when much of the sample deployed to Iraq or Afghanistan (12). Furthermore, Iraq and Afghanistan war veterans who are overweight or obese are at increased risk for hypertension (13). Compared with their nonveteran peers, young adult veterans may be more affected by stress, depression, substance and alcohol abuse, and sleep loss, all of which have been linked to weight-related behaviors and obesity (14).

Although it is easy to focus on risk behaviors, there are also potentially strong protective factors relating to tobacco use and weight gain that may be leveraged to reduce chronic disease risk. For instance, military culture highly values physical fitness. Evidence exists that the veterans of the Iraq and Afghanistan wars are more likely to engage in strength training compared with their nonveteran peers (15). Additionally, the military breeds a strong sense of camaraderie and community, which can counteract stress and potentially assist with making a behavior change such as quitting tobacco use or changing one's diet. A structural asset for this population is the VA health care system. All veterans of the Iraq and Afghanistan wars are eligible for at least 5 years of care through the VA after they separate from military service. Although the VA, like most health care systems, has had more focus and expertise in chronic disease treatment, this infrastructure could be channeled for primary prevention.

A Unique Window of Opportunity

Both tobacco use and weight-related behavior patterns appear to be established during young adulthood and persist throughout life. Although most smokers had their first cigarette while they were adolescents, most young smokers have not established their smoking pattern before they reach age 18. Young adulthood appears to be the period when smoking patterns "lock in," as few people initiate or quit smoking in the decade following young adulthood (in this particular study, ages 28-40 y) (16). Weight-related behaviors also appear to remain consistent after young adulthood (14). This finding suggests that the period after deployment may be an effective time to attempt to set a beneficial health behavior trajectory.

Another reason to intervene during young adulthood is that the process of developing chronic disease begins often decades before symptoms emerge. For instance, most of the deaths associated with smoking can be avoided by quitting smoking by age 35 (17). Consequently, eliminating tobacco use at a young age would have an immense health impact for the population of young adult Afghanistan and Iraq war veterans who smoke.

Proactively Promoting Healthful Behaviors Among Young Veterans

What is needed to develop interventions, opportunities, policies, and systems that promote healthful lifestyles for returning veterans? First, we need more data that can describe the magnitude and correlates of the problem of risk behaviors in the population of young veterans. Our data-gathering processes must be updated to be consistent with 21st-century young adult culture. For instance, researchers and research institutions should be open to recruiting participants for studies by using social networking websites, surveying online, and formulating questions that are relevant to young adults. The data should tell us both who is at risk and how personal, cognitive, and environmental factors contribute to the establishment of behaviors and enable or impede behavior change. In the absence of knowledge about these issues in this new cohort of veterans, promoting more healthful lifestyles and providing preventive health services aimed at reducing health risk behaviors among Iraq and Afghanistan war veterans is an insurmountable challenge.

The next step is to develop innovative interventions and craft policies that steer young veterans toward healthful behaviors long before signs and symptoms of chronic disease appear. Policies such as improving the nutrition of food served at National Guard drill weekends may contribute to positive dietary change. Other interventions could include developing opportunities for physical activity for veterans, such as fitness classes held at VA clinics. Ensuring that all Iraq and Afghanistan war veterans have access to free evidence-based tobacco use cessation aids could also reduce barriers to cessation.

To reach young veterans, we need to establish partnerships that cut across traditional institutional domains, for example. Although the VA is the largest health care provider to veterans, many returning veterans are reluctant to use VA services. Since the wars began, only 51% of eligible Iraq and Afghanistan war veterans have sought care through the VA (1). This is in part because of unfamiliarity with the system, distance from the VA medical centers, misconceptions about the quality of VA care, or reluctance to visit a large VA hospital for routine care. One pressing issue in providing any kind of services to veterans, especially those who have separated recently, is that the Military Health System and VA are not well-integrated, which makes continuity of any type of service more challenging. The Post-9/11 Veterans Educational Assistance Act of 2008 has enabled hundreds of thousands of Iraq and Afghanistan war veterans to attend college (18-19). Some natural partnerships could emerge between universities and organizations devoted to promoting veteran health.

Adoption of healthful lifestyles has the benefits of improved health, reduced disease, and an enhanced quality of life for years to come. As young Iraq and Afghanistan war veterans return, many will interact with organizations that have a stake in their well-being, which represents an opportunity to emphasize ways to prevent chronic illness in this population.

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ORIGINAL RESEARCH

Implementing the MOVE! Weight-Management Program in the Veterans Health Administration, 2007-2010: A Qualitative Study

Bryan J. Weiner, PhD; Lindsey Haynes-Maslow, MHA; Leila C. Kahwati, MD, MPH; Linda S. Kinsinger, MD, MPH; Marci K. Campbell, PhD

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PEER REVIEWED

Abstract

Introduction
One-third of US veterans receiving care at Veterans Health Administration (VHA) medical facilities are obese and, therefore, at higher risk for developing multiple chronic diseases. To address this problem, the VHA designed and nationally disseminated an evidence-based weight-management program (MOVE!). The objective of this study was to examine the organizational factors that aided or inhibited the implementation of MOVE! in 10 VHA medical facilities.

Methods
Using a multiple, holistic case study design, we conducted 68 interviews with medical center program coordinators, physicians formally appointed as program champions, managers directly responsible for overseeing the program, clinicians from the program's multidisciplinary team, and primary care physicians identified by program coordinators as local opinion leaders. Qualitative data analysis involved coding, memorandum writing, and construction of data displays.

Results
Organizational readiness for change and having an innovation champion were most consistently the 2 factors associated with MOVE! implementation. Other organizational factors, such as management support and resource availability, were barriers to implementation or exerted mixed effects on implementation. Barriers did not prevent facilities from implementing MOVE! However, they were obstacles that had to be overcome, worked around, or accepted as limits on the program's scope or scale.

Conclusion
Policy-directed implementation of clinical weight-management programs in health care facilities is challenging, especially when no new resources are available. Instituting powerful, mutually reinforcing organizational policies and practices may be necessary for consistent, high-quality implementation.

Introduction

In 2006, the Veterans Health Administration (VHA) issued a policy directing implementation of an evidence-based weight-management program to help reduce obesity rates among veterans receiving care from VHA (1). Created by VHA's National Center for Health Promotion and Disease Prevention (NCP) on the basis of guidelines from the National Institutes of Health (2,3) and other literature, the MOVE! weight-management program uses a population-based clinical approach to disease in which all patients seen in VHA medical facilities are systematically screened for obesity and offered evidence-based tiered treatment options tailored to their needs and preferences. In order of increasing intensity, treatment options include self-management support, individual counseling or group sessions, clinically supervised weight-management medications, and, in some facilities, brief residential treatment or bariatric surgery. Delivered by a multidisciplinary team encompassing primary care, dietetics, behavioral health, and physical

activity, MOVE! is a comprehensive approach to weight loss and maintenance that promotes behavior change, healthy nutrition, physical activity, and psychological well-being. MOVE! addresses an urgent need: 35% of VHA primary care enrollees — representing 90% of all of VHA patients — are estimated to be obese (4,5) and, therefore, at higher risk for chronic diseases such as hypertension, cardiovascular disease, stroke, and osteoarthritis (6).

NCP took several steps in designing and disseminating MOVE! to ensure rapid adoption and implementation (7). First, it developed an easy-to-use toolkit that contained patient handouts, promotional brochures, clinical references, curriculum modules, online staff training, implementation checklists, administrative manuals, and marketing materials. Second, it tested the program for feasibility in 17 VHA medical facilities and revised program content and materials on the basis of staff and patient feedback. Third, NCP secured endorsements for the program from influential internal stakeholders, culminating in the issuance of a VHA policy in March 2006 requiring all facilities to implement MOVE! or an equivalent multidisciplinary weight-management program. Fourth, NCP held 2 national training conferences and biweekly teleconferences with program coordinators in the 21 regional VHA networks. Finally, VHA policy required facilities to complete an annual report on their weight-management services and prepare to be held accountable for their obesity screening rates as part of VHA's performance measurement system.

By 2009, nearly all (98.7%) of the 155 medical centers in VHA reported having MOVE! programs in place (7). A VHA evaluation conducted in 2010 showed that, overall, the program has had a modestly positive effect on weight change at 6 months (8). However, facilities varied in the speed with which they implemented the program and the level of program activity they achieved 12 to 36 months after the issuance of the policy. Given the national scope of the program's dissemination within a single health care system, the MOVE! program offers a unique opportunity to examine the local organizational factors that aided or hindered program implementation among multiple facilities. The objective of this study was to examine the organizational facilitators and barriers of MOVE! implementation in 10 VHA medical facilities.

Methods

Conceptual framework

We used an organizational model of innovation implementation to guide the study (9-11). The model posits that the effective implementation of an innovation (ie, consistent, high-quality delivery of MOVE!) is a function of the organization's readiness for change; level of management support for the innovation; amount of resources available for implementation; presence of an innovation champion; extent to which the innovation fits local task demands, such as work processes and patient preferences ("innovation-task fit"); and extent to which intended implementers of the innovation, such as physicians, nurses, and allied health professionals, perceive that innovation implementation fosters the fulfillment of their values ("innovation-values fit").

Study design and sample

We used a multiple, holistic case study design; the VHA medical facility was the unit of analysis (12). Case study methods are well suited for studying implementation processes, which tend to be fluid, nonlinear, and context-sensitive (13-15). We invited 126 VHA facilities with at least 30 active MOVE! participants in 2006 to participate in our study. Of the 14 facilities that accepted our invitation, we purposefully selected 10 to reflect diversity in geographic region, organizational size, and organizational complexity (Table 1). National program officials assured us that the range of MOVE! program activity among participating facilities, as indicated by growth in the number of new program participants and level of program activity (eg, number of program participants receiving individual face-to-face or telephone counseling or group education), reflected the wide range of MOVE! program activity among VHA facilities.

This study was reviewed for human subjects protection and approved by all participating VHA facility institutional review boards and by the review boards of the 2 coordinating centers.

Data collection

From 2007 through 2010, a researcher (B.J.W.) with 15 years of experience conducting qualitative research, interviewed 68 MOVE! representatives. He asked each VHA facility to identify the MOVE! coordinator, the program's physician champion (formally appointed), the facility manager directly responsible for overseeing the program, an opinion leader in primary care, and 3 or 4 members of the program's multidisciplinary team (Table 2). Of the 74 people contacted, 5 did not respond to recruitment e-mails, and 1 could not be reached because she was on maternity leave. The interviewer had no previous relationship with interview participants. He used semistructured interview guides informed by the study's conceptual framework to gather information about the program's staffing, structure, and operations and facilitators and barriers of program implementation (Appendix). The 30- to 60-minute telephone interviews were recorded with permission from the participants and transcribed verbatim.

Data analysis

Analysis proceeded in 3 steps. First, we used Atlas.ti version 5.0 qualitative data analysis software (Scientific Software

Development GmbH, Berlin, Germany) to code the data. Using a codebook informed by the conceptual framework, 2 investigators independently coded the transcripts, compared their coding, and reconciled coding discrepancies through discussion until consensus was reached. Second, we conducted a within-case analysis of facilitators and barriers for each facility. We generated reports of all text segments for each code and wrote memoranda in which we assessed the degree to which the construct emerged in the data (its "strength"), identified themes in the coded data for the construct, and assessed the degree to which the construct positively or negatively affected implementation (its "valence"). We then created a checklist matrix to visually display the construct valences and support the identification of patterns within medical facilities (16). Finally, we developed a conceptually clustered matrix to enable a between-case analysis of facilitators and barriers by construct (16). Two investigators independently conducted the within- and between-case analyses, compared results, discussed findings, reconciled discrepancies, and produced a final conceptually ordered matrix.

Results

All 10 VHA medical facilities encountered facilitators and barriers as they implemented MOVE! (Table 3). Although some facilities reported more barriers than others, no facility had barrier-free implementation. Among the 10 facilities, the organization's readiness for change and the presence of an innovation champion most consistently served as facilitators of MOVE! implementation. Other organizational factors, such as resource availability and innovation-values fit, either acted as barriers to implementation or exerted mixed effects (Table 4) on implementation. None of the barriers observed prevented any of the 10 facilities in this study from implementing MOVE! However, interview participants cited the barriers as obstacles to be overcome, worked around, or accepted as limits on the program's scope or scale.

All facilities either had an existing weight-management program or had participated in the pilot phase of MOVE! before issuance of VHA policy. Moreover, all facilities knew that the VHA central office would soon hold them accountable for their obesity screening rates (a key factor leading to increased demand for MOVE! treatment). However, preexisting weight-management programs at 3 facilities provided limited preparation for MOVE! because they focused primarily on healthful eating and offered only group education. In 1 facility, previous programs were perceived as failures, which undermined organizational readiness. Even with pilot-phase experience, 2 facilities struggled to offer the full range of tiered treatment options of MOVE!. Delaying accountability for obesity screening gave facilities time to implement MOVE!; the delay, however, had the unintended effect of reducing the sense of urgency during the interim period, leading to slower MOVE! implementation than interview participants at 2 facilities had desired. Finally, obesity screening rates were added to an already long list of performance indicators at 2 facilities, which may have diluted the motivational effect of such accountability.

Interview participants often, but not always, characterized the facility's senior managers (eg, facility director, chief of staff, facility chief nurse, and chief administrative officer) as supportive of MOVE!. In 2 facilities, senior managers allocated resources for hiring staff or purchasing materials during the pilot phase or immediately after the national launch. However, in 4 other facilities, senior management support did not translate into resource allocation until facilities became accountable for their obesity screening rates. Moreover, the support of service-line chiefs for MOVE! was highly variable, ranging from enthusiasm to passive acceptance to skepticism. (Service-line chiefs are the formal leaders of clinical service lines [eg, primary care service-line chief]; they report to senior managers.) Service-line chief support varied as a function of where the MOVE! program was based administratively. In 2 facilities where MOVE! was based in nutrition service, for example, support from the primary care service-line chief was sometimes tepid. In 3 facilities, interview participants attributed variable service-line chief support as a barrier to creating and sustaining a multidisciplinary team approach to MOVE! program delivery.

In several facilities, interview participants cited limited resource availability as a significant barrier to MOVE! implementation. Three facilities praised the toolkit that NCP developed for MOVE! implementation and delivery. The national program launch, however, provided no additional funding for facilities to implement MOVE!. With no additional funding, 5 facilities launched MOVE! by assigning existing clinical staff the additional duty to implement and deliver MOVE!. When facilities became accountable for their obesity screening rates, facility managers at 2 facilities proved more receptive to requests to hire full-time staff for MOVE!. In all 10 facilities, however, MOVE! relied heavily on the staff who were personally committed to supporting and delivering the program in addition to performing their other clinical or administrative duties. Four facilities coped with limited staffing resources by involving psychiatric residents, psychology interns, and nutrition students from nearby universities. Interview participants generally reported that MOVE! is understaffed in their facility and that the understaffing limits the number of veterans served, the range of tiered treatment options, and the multidisciplinary approach. In 5 facilities, for example, interview participants reported little or no staff support in physical activity disciplines (eg, recreational therapy, physical therapy, occupational therapy). Five others reported shortages in behavioral health disciplines (eg, psychology, social work).

VHA policy required all facilities to assign a physician champion for MOVE! In most facilities, interview participants

reported that the physician champion was actively engaged in MOVE! and served as a respected ambassador for the program among primary care physicians and an influential advocate for additional resources. In 2 facilities, however, the physician champion was described as uninvolved in MOVE! or passive as a spokesperson for the program. In these facilities, interview participants sometimes identified the MOVE! coordinator or another MOVE! staff member as an innovation champion. These people, however, did not have the position, prestige, or influence of the physician champion.

Primary care physicians are expected to screen patients for obesity, counsel them about the health risks and consequences of obesity, and refer them to MOVE! if they seem interested or ready. Interview participants at 7 facilities noted that primary care physicians strongly believe in the value of prevention and perceive weight management as necessary for reducing illness among their patients and to VHA as a health care system. As a comprehensive, multidisciplinary weight-management program that offers tiered treatment options tailored to patient needs and interests, the MOVE! program fits the values of many primary care physicians. However, interview participants at 4 facilities noted that some primary care physicians doubt the program's efficacy to produce and sustain enough weight loss to make a noticeable impact on patients' health. This skepticism, plus the urgency of patients' more pressing medical issues, led to less support from some physicians.

All 10 facilities attempted to tailor MOVE! to better fit their organization's capacity to implement it. These modifications included adding or removing clinical reminders for obesity screening, tailoring procedures for enrolling patients, and offering various levels of the MOVE! program at a facility. Eight facilities noted that primary care nurses and physicians felt that tasks associated with MOVE!, such as the clinical reminder to screen for obesity or attending multidisciplinary meetings, were time consuming and burdensome to already heavy workloads. Two facilities decided to remove the clinical reminder altogether.

Enrolling patients in MOVE! was challenging for some facilities. One facility reported patient reluctance to participate in a weight-loss program. Additionally, 4 facilities had difficulty motivating patients to practice behavior changes, such as exercising and eating healthfully, outside of the MOVE! classroom. Implementation of the most basic treatment option — self-management supported by frequent telephone contact — varied among facilities. Four facilities discontinued this level because they had difficulty reaching people by telephone and it was time consuming for staff and volunteers to make calls. One facility could make initial telephone calls but noted that staff availability limited the number of follow-up calls. Another found this level was more convenient for patients living farther away.

Discussion

Organizational facilitators and barriers played a salient role in the implementation of MOVE! — the only nationally implemented, evidence-based weight-management program that focuses on reducing obesity rates among US veterans receiving care at VHA facilities. Of the 6 organizational factors examined in this study, organizational readiness for change and innovation champions were the most consistent facilitators of MOVE! implementation. Management support, resource availability, innovation-values fit, and innovation-task fit either acted as barriers to implementation or exerted mixed effects on implementation.

Our findings contribute to a limited body of research on the organizational context of innovation implementation in health care settings (17,18). A study with similar findings (19) observed that resource limitations posed a substantial barrier to the implementation of quality improvement and patient safety interventions in infection prevention. Our results suggest that organizational accountability through explicit performance measurement can prompt health care organization leaders to allocate scarce resources to support program implementation and spur program staff to find creative solutions to resource constraints. Several studies indicate that informal, emergent innovation champions play a role in innovation implementation (9,20-24). Our results suggest that formally appointed innovation champions can also aid implementation by helping secure resources, overcome obstacles, and encourage innovation.

This study had several limitations. Case study research emphasizes depth over breadth and insight over generality (12,15). Ten cases do not provide a strong basis for statistically generalizing study results to all VHA facilities. Although national program officials (L.C.K. and L.S.K.) report many VHA facilities encountered the same or similar organizational facilitators and barriers as those identified in this study, a national survey of randomly sampled VHA facilities would be needed to document the frequency and distribution of facilitators and barriers. As is true of all research, case study research involves an irreducible element of expert judgment. We used time-honored case study research methods, but we cannot discount the possibility that investigator bias in interpretation influenced our results.

We suggest 2 directions for future research. First, the theory and practice of the multilayered complexities of management support need to be understood. Senior management support is often cited as necessary for innovation implementation (14,25-29), but our study shows that support from middle managers (eg, service-line chiefs) and even direct supervisors can also aid or hinder implementation. Second, innovation champions are often conceptualized as people who, driven by passion and enthusiasm, not formal designation, step outside of their organizationally

prescribed roles to advocate for innovations (9,20-24). Our study shows, however, that formally designated innovation champions promoted implementation in many facilities; informal champions surfaced only when formally designated champions left a gap to be filled. The emergence of informal champions, rather than being lauded, should perhaps be considered a sign that the organization's formal roles, structures, and policies are not aligned with its goals for program implementation. This conjecture could be empirically investigated.

We also learned 2 practical lessons that may help other health care or public health systems to implement new programs amid competing organizational priorities and a lack of new resources. First, organizational leaders directing implementation of new programs must put into place powerful, mutually reinforcing policies and practices that make implementation expected, supported, and rewarded. Such policies and practices include setting measurable goals for implementation, instituting a realistic schedule for meeting those goals, monitoring progress against goals, recognizing those who meet goals, and holding accountable those who do not. These policies and practices must be clearly and consistently communicated, and they must command the attention of those charged with implementation. Second, the policies and practices must cascade throughout the multiple levels of organizational hierarchy to form an aligned, interlocking implementation strategy. Otherwise, an implementation gap arises between top management and the front line of service provision to veterans.

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Tables

Table 1. Veterans Health Administration (VHA) Medical Centers Included in Qualitative Study on Implementation of the MOVE! Weight-Management Program, United States, 2007-2010

Return

Medical Facility	Census Region	No. of Unique Outpatient Visits[a]	Facility Complexity Rating[b]	No. of New Unique MOVE! Patients[c]	No. of Unique MOVE! Visits[c,d]
1	West North Central	37,221	1C	207	2,977
2	West South Central	85,112	1A	81	409
3	East North Central	41,479	1B	195	758
4	New England	63,294	1A	104	581
5	East North Central	54,494	1A	427	2,914
6	West	65,771	1A	374	1,074
7	New England	54,401	1A	129	960
8	Mountain	39,869	1B	259	574
9	West	63,514	1A	224	358
10	East North Central	77,968	1A	632	1,706

[a] Data were obtained for fiscal year 2006 from the VHA Service Support Center Unique Patient Data Cube (unpublished data).
[b] The VHA categorizes VHA Medical Centers according to a defined complexity model for the purposes of performing program and organization analyses, making decisions on organizational structure, and setting senior executive pay levels. The model uses data on patient population served (including numbers served and patient risk as measured by the diagnostic cost group), clinical services complexity (eg, intensive care units, specialized clinical programs), and the scope of the graduate medical education and research enterprise of the facility. Facilities are categorized into 1 of 5 complexity levels: IA (most complex), IB, IC, 2, or 3 (least complex).
[c] Data were obtained for fiscal year 2006 from the VHA Service Support Center MOVE! Visits Data Cube (unpublished data).
[d] Visits include group, individual, and telephone communication. Visits are identified through the use of a unique administrative code required by VHA policy.

Table 2. Number of Interview Participants, by Veterans Health Administration (VHA) Facility and Organizational Role, Qualitative Study on Implementation of the MOVE! Weight-Management Program, United States, 2007-2010

Return

Facility	Organizational Role[a]					
	Coordinator	Physician Champion	Facility Manager	Multidisciplinary Team Member	Opinion Leader	Total
1	2	1	1	3	1	8
2	1	0[b]	1	3	1	6
3	1	1	0[c]	3	0[c]	5
4	1	1	1	3	1	7
5	1	1	1	3	1	7
6	1	1	0[c]	5	1	8
7	1	1	1	3	1	7
8	1	1	1	3	1	7
9	1	1	1	1[d]	1	5
10	1	1	1	4	1	8
Total	11	9	8	31	9	68

[a] The coordinator is the clinical staff person responsible for program coordination, communication, and reporting. The physician champion is responsible for facilitating program implementation and overseeing the clinical aspects. The facility manager is the administrator directly responsible for overseeing the program; facility managers had different titles in different VHA facilities (eg, associate chief of staff for ambulatory care, primary care service line manager, nutrition/food service chief). Multidisciplinary team members are clinical staff from the 4 core disciplines involved in program delivery: dietetics, primary care, physical activity, and behavioral health. The opinion leader is a primary care physician who is not directly involved in the program but is considered influential in primary care.
[b] Physician was on maternity leave; we were unable to reach her.
[c] Participant did not respond to recruitment e-mail.
[d] Two interview participants did not respond to recruitment e-mail.

Table 3. Organizational Factors Associated With Implementation of MOVE! Weight-Management Program, United States, 2007-2010

Return

	Facility									
	1	2	3	4	5	6	7	8	9	10
Organizational readiness[a]	+	+	+/−	+/−	+	+	+	+	−	+
Management support[b]	+/−	−	−	+/−	+	+/−	+/−	+	+/−	+/−

Resource availability[c]	+/−	−	+/−	+/−	+/−	+/−	+/−	+	−	+/−
Innovation champion[d]	+	−	+	+	+	+	+	+/−	+/−	+
Innovation-values fit[e]	+/−	+/−	−	−	+/−	+/−	+	+/−	−	+/−
Innovation-task fit[f]	+/−	−	−	−	+/−	+	+	+/−	−	+/−

Abbreviations: + indicates factor was present and favorable for implementation; −, factor was absent or unfavorable for implementation; +/−, factor was present but mixed (favorable and unfavorable) for implementation.
[a] Refers to the extent to which expected implementers and users of an innovation are psychologically and behaviorally prepared to make the necessary changes in organizational policies and practices.
[b] Refers to managers' shared resolve to pursue courses of action that promote the successful implementation of the innovation.
[c] Refers to the accessibility of financial, material, or human assets that can be used to support initial and ongoing innovation use.
[d] Refers to a charismatic person who supports the innovation, thus overcoming the indifference or resistance that a new idea often provokes in an organization.
[e] Refers to the extent to which targeted employees perceive that innovation use will fulfill their values.
[f] Refers to the extent to which the innovation is compatible with task demands, work processes, and organizational capabilities.

Table 4. Facilitators and Barriers to Implementing MOVE! in Veterans Health Administration (VHA) Medical Facilities, United States, 2007-2010

Return

Construct	Facilitator	Barrier
Organizational readiness	• Prior weight-management programs and MOVE! pilot prepared sites for MOVE!	• Prior programs provided only partial preparation (eg, nutrition focus, classes only)
	• Impending performance indicator created motivational context for implementation	• Impending performance indicator part of much larger set of performance indicators
Management support	• Managers and chiefs generally supportive	• Service-line chief support highly variable
	• Managers (re)allocate limited resources	• Senior managers generally unfamiliar with MOVE!
Resource availability	• VHA's National Center for Health Promotion and Disease Prevention generated useful program materials and implementation tools	• Program underresourced in clinical and administrative staffing
	• Committed staff and clinical trainees filling staffing gap	• Space for MOVE! often too small, poorly configured
Innovation champion	• Physician champion is credible ambassador with physician and management audiences	• Physician champion engagement in MOVE! highly variable across facilities
	• Physician champion sometimes a powerful advocate for resources	• Physician champion sometimes lacks political savvy and bargaining skills
Innovation-values fit	• Prevention is a moderate- to high-intensity value in VHA	• Physicians somewhat skeptical about program's efficacy
	• Weight management viewed as important to improving health	• Prevention competes with acute care for attention and resources
	• Multiple program levels fit veterans' needs	• Veterans' motivational readiness

		highly variable
Innovation-task fit	• Clinical reminder provides timely cue to action	• Primary care workload is overwhelming

Appendix. Interview Guide for Qualitative Study on Implementation of the MOVE! Weight-management Program, Veterans Health Administration, United States, 2007-2010

Organizational readiness for change refers to the extent to which targeted organizational members (especially the implementers and intended users) are psychologically and behaviorally prepared to make the changes in organizational policies and practices that are necessary to put the innovation into practice and to support innovation use.

	Facility Manager	MOVE! Coordinator	MOVE! Physician Champion	MOVE! Multidisciplinary Team	Opinion Leader
What prompted your facility to adopt MOVE!? Was the decision externally driven or internally motivated? What issues did you all consider in deciding to adopt MOVE!? What were the "pros" and "cons," so to speak?	X	X	X		
How committed were your facility's senior managers? How committed were your facility's service line chiefs? How committed were your facility's [providers, clinicians]? Where there any important groups or individuals who seemed unsure or perhaps reluctant?	X	X	X	X	X
Prior to MOVE!, what kinds of services did your facility offer to patients who were overweight or obese? Were these services multidisciplinary? Did people see MOVE! as a better alternative? Why or why not?	X	X	X	X	X
How confident were you that your facility could implement MOVE! successfully? What did "successful implementation" mean for you? Were you more confident about some elements of MOVE! than others? What prompted you to feel this confident? Who shared your level of confidence? Who did not?	X	X	X	X	X

Management support refers to facility or VISN managers' shared resolve to pursue courses of action that promote the successful implementation of the innovation. Although titles vary, management includes facility director, facility chief of staff, facility chief nurse, facility chief administrative officer, facility service line chiefs, VISN network director, VISN chief medical officer, and VISN clinical leads. Although some MOVE! coordinators wear "management hats," the coordinator role is not considered a management position.

	Facility Manager	MOVE! Coordinator	MOVE! Physician Champion	MOVE! Multidisciplinary Team	Opinion Leader
How supportive of MOVE! are your facility's senior managers? Can you think of specific things that they have done or said that demonstrate support, or lack of support, for MOVE!? Are some more supportive than others? How has their level of support	X	X	X	X	X

changed since you first got started? What accounts for these changes?					
How supportive of MOVE! are your facility's service line chiefs? Can you think of specific things that they have done or said that demonstrate support, or lack of support, for MOVE!? Are some more supportive than others? How has their level of support changed since you first got started? What accounts for these changes?	X	X			

Resource availability refers to the accessibility of financial, material, or human assets that can be used to support initial and ongoing innovation use.

	Facility Manager	MOVE! Coordinator	MOVE! Physician Champion	MOVE! Multidisciplinary Team	Opinion Leader
Are there enough providers in the core disciplines in your facility to provide MOVE! in your facility? Are there enough clinicians to increase the current level of MOVE! in your facility? If not, which clinical disciplines are in short supply? What accounts for that? What could be done to improve provider availability?		X	X	X	X
How satisfied are you with the *space* available for group meetings? Has the quality or quantity of space affected the number, frequency, or size of group sessions? What needs for space exist? What could be done to address these needs for space?		X		X	
How satisfied are you with the *equipment* available to support MOVE! (eg, computers, printers, and furniture)? Has the quality or quantity of equipment affected MOVE! implementation? What needs equipment exist? What could be done to address these needs for equipment?		X		X	
Does your VISN provide financial resources for MOVE! beyond usual patient care dollars? If so, how much and for what purpose? If not, has your facility requested it? What happened? Likely to change?	X	X			

Implementation policies and practices refer to the plans, practices, structures, and strategies that an organization employs to put the innovation into place to support innovation use.

	Facility Manager	MOVE! Coordinator	MOVE! Physician Champion	MOVE! Multidisciplinary Team	Opinion Leader
Please describe how you have implemented MOVE!. • How are patients screened for BMI? • Who determines eligibility? Gives risk education? Offers MOVE!? • How do patients fill out MOVE!23? • Who reviews MOVE!23 results with patients? • Who helps patients set goals?		X	X (first 2 bullets only)	X	X (first 2 bullets only)

• Who schedules follow-up MOVE! appointments? • Who does the follow-up? How is it done: primary care, consults, groups? • Who tracks patients' progress?					
Does your facility do "same day" enrollment? If so, what does it take to make that work? How well is it working? If not, have you considered it? What would it take to do it?		X	X	X	
How do providers involved in MOVE! communicate and coordinate with each other? [methods, frequency, quality of communication]		X	X	X	
Have you established clinic profiles for MOVE!-related appointments? Do you have a clinical reminder to assist with screening? Do you have the toolbar launch for the MOVE!23 installed on CPRS? Do you have a MOVE!-related progress note title in the list of titles? Can you query your local VISTA for all patients enrolled in MOVE! for tracking purposes?		X	X	X	
How does your facility train new providers in MOVE!?		X	X	X	
What ongoing education and training does your facility provide with regard to MOVE!? Obesity and overweight?		X	X	X	
Has your facility marketed MOVE! to patients? If so, what have you done? What works? What doesn't? If not, do you plan to do so? What would it take to do so?		X	X	X	
How often do providers receive feedback on facility-level performance on MOVE!? What kinds of feedback do they receive? How do they get that feedback?	X	X	X	X	
How much time or effort is required to provide MOVE! on a daily basis? Did getting MOVE! implemented take more time or effort than expected? Has the amount of time or effort to provide MOVE! decreased as your facility has gained more experience with MOVE!?		X	X	X	

Innovation-task fit refers to the extent to which the innovation is compatible with task demands, work processes, and organizational capabilities.

	Facility Manager	MOVE! Coordinator	MOVE! Physician Champion	MOVE! Multidisciplinary Team	Opinion Leader
What aspects of MOVE! are most feasible? What makes them so?				X	
What aspects of MOVE! are least feasible? What makes them so?				X	
How could MOVE! be redesigned to make it more				X	

feasible?					

Implementation climate refers to organizational members' shared perceptions of implementation policies and practices in terms of their meaning and significance for innovation use.

	Facility Manager	MOVE! Coordinator	MOVE! Physician Champion	MOVE! Multidisciplinary Team	Opinion Leader
How involved is the physician champion? What does he or she do? How visible is he or she? Could he or she make things happen to support MOVE!? Does he or she make things happen?	X	X		X	X
How involved is the facility MOVE! coordinator? What does he or she do? How visible is he or she? Could he or she make things happen to support MOVE!? Does he or she make things happen?	X		X	X	X
Do clinicians here feel that they are expected to participate in MOVE!? Do they know what they are supposed to do? Do they feel that they have the support they need? Do they feel that their participation in MOVE! is recognized and valued?	X	X	X	X	X
Do providers here feel that they are expected to participate in MOVE!? Do they know what they are supposed to do? Do they feel that they have the support they need? Do they feel that their participation in MOVE! is recognized and valued?	X	X	X	X	

Innovation-values fit refers to the extent to which targeted employees perceive that innovation use will foster the fulfillment of their values. Values are concepts or beliefs that a) pertain to desirable end-states or behaviors, b) transcend specific situations, and c) guide the selection and evaluation of behavior and events.

	Facility Manager	MOVE! Coordinator	MOVE! Physician Champion	MOVE! Multidisciplinary Team	Opinion Leader
What motivates provider to participate in MOVE!? Do providers feel comfortable with MOVE!? Why or why not? What do they like about MOVE!? What do not like?	X	X	X	X	X
In what ways does MOVE! fit with management's priorities? In what ways does MOVE! not fit with management's priorities?	X	X	X	X	X

Innovation champion refers to a charismatic individual who throws his/her weight behind the innovation, thus, overcoming the indifference or resistance that a new idea often provokes in an organization.

	Facility Manager	MOVE! Coordinator	MOVE! Physician Champion	MOVE! Multidisciplinary Team	Opinion Leader
Is there a particular provider, clinician, or manager who really goes above and beyond the call of duty to make MOVE! succeed? Is there someone who does far more than what he or she is expected to do?	X	X	X	X	X

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ORIGINAL RESEARCH

Nicotine Dependence and Its Risk Factors Among Users of Veterans Health Services, 2008-2009

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PEER REVIEWED

Abstract

Introduction
Tobacco use is the leading preventable cause of death in the United States and is disproportionately higher among veterans than nonveterans. We examined the prevalence of nicotine dependence and its associated risk factors among veterans who used health services in the US Department of Veterans Affairs (VA) system.

Methods
Using a case-control design, we compared all VA health service users in fiscal year 2008-2009 (N = 5,031,381) who received a nicotine dependence diagnosis with those who did not. Independent risk and protective factors associated with receiving a nicotine dependence diagnosis were identified using logistic regression analysis. We conducted subgroup analyses on 2 groups of particular policy concern: homeless veterans and veterans who served in Iraq and Afghanistan.

Results
Among all recent VA health service users, 15% (n = 749,353) received a diagnosis of nicotine dependence. Substance abuse, other mental health diagnoses, and homelessness were identified as major risk factors. Veterans who served in Iraq and Afghanistan were not found to be at increased risk compared to veterans from other war eras. Major risk and protective factors within the subgroups of homeless veterans and veterans who served in Iraq and Afghanistan were broadly similar to those in the general VA population.

Conclusion
Given that other studies have found higher rates of nicotine dependence among veterans, this risk behavior may be underdiagnosed in VA medical records. Veterans who are homeless or have mental health or substance abuse problems are at highest risk and should be targeted for smoking prevention and cessation interventions. These results support, in principle, efforts to integrate smoking cessation programs with mental health and homeless services.

Introduction

Tobacco use is the leading preventable cause of illness, disability, and premature death in the United States (1). Smoking is responsible for 1 in 5 deaths, resulting in approximately 443,000 avoidable deaths per year (2). These rates are disproportionately higher among veterans because both active-duty personnel and veterans are more likely to have ever smoked or to currently smoke than the adult civilian nonveteran population (3,4). Thus, Department of Veteran Affairs (VA) provides smoking cessation interventions and programs to its health system users (5,6). However, most veterans who smoke and use VA health services report they do not receive tobacco cessation treatment (7). Identifying veteran characteristics related to tobacco use can clarify who is most likely to benefit from smoking prevention and cessation interventions and may enhance VA efforts to reduce smoking and smoking-related illnesses.

A nicotine dependence diagnosis is given to people who use tobacco regularly and have become chronically dependent on nicotine. Epidemiological studies have found a 13% point prevalence (8) and 24% lifetime prevalence (9) for nicotine dependence in the general US adult population. Two recent studies found that 26% to 27% of veterans smoke (10,11). No published research study could be found on the prevalence of diagnosed nicotine dependence among VA service users; thus, the extent to which VA clinicians are assessing and documenting nicotine use and dependence is unclear.

Factors related to smoking cessation have been widely studied; preventing nicotine dependence and identifying predictors of it, less so. Tobacco use is more prevalent and intense among psychiatric populations than the overall population. Up to 41% of adults with mental illness smoke (12-14). These adults may be particularly susceptible to nicotine addiction because tobacco positively influences mood (15). Many people who abuse other substances also smoke, and an especially strong correlation has been found between smoking and alcohol abuse (13). However, this association has not been fully investigated in large studies of veterans.

Research is inadequate on nicotine dependence in 2 groups of particular interest to the VA health system: homeless veterans and veterans who served in Iraq and Afghanistan in Operation Iraqi Freedom and Operation Enduring Freedom (OIF/OEF). Homelessness among veterans has been a national problem for more than 2 decades (16-19), and recently interest has been renewed in ending veterans' homelessness and providing all necessary health care interventions to this population (20). As the United States continues to wage war in the Middle East, health care providers have been especially concerned about OIF/OEF veterans who served in Iraq and Afghanistan, who are at risk of developing various physical and mental health problems postdeployment and after military discharge (21-24). Some studies suggest higher rates of smoking among these veterans (6). Because both of these groups are priorities for VA health services, identifying factors related to nicotine dependence in these 2 groups may help target prevention efforts and curb development of smoking-related illnesses.

The objective of this study was to examine all recent users of VA health services, a group readily available for smoking prevention and cessation interventions, to identify the prevalence of nicotine dependence diagnoses and determine the risk factors associated with receiving such a diagnosis. A secondary objective was to examine risk factors for nicotine dependence among homeless veterans and OEF/OIF veterans.

Methods

Study design

Using a cross-sectional case-control study design, we analyzed VA administrative data for all veterans who used VA health services in fiscal year (FY) 2009 (October 1, 2008, to September 30, 2009) to retrospectively compare veterans who had a nicotine dependence diagnosis to those who did not. We compared groups of veterans on the basis of the following characteristics: sociodemographics, homeless status, OEF/OIF status, use of mental health services, urban/rural residence, income, disability status, and mental health diagnoses. We conducted secondary analyses on homeless veterans and OIF/OEF veterans to identify risk factors among these 2 groups. A nicotine dependence diagnosis, not nicotine dependence per se, was the outcome variable in analyses.

Sample

The total sample consisted of 5,031,381 veterans who used VA health services during FY 2009. We identified nicotine dependence if the veteran received an *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) (www.cdc.gov/nchs/icd9.htm) diagnostic code of 305.1 during FY 2009, as documented in national administrative files.

We defined homeless veterans as veterans who received either specialized VA homeless services or an ICD-9-CM V60.0 diagnostic code (indicating lack of housing) during FY 2009. We identified OIF/OEF veterans through a file provided to the VA by the Department of Defense.

Measures

Sociodemographic characteristics included sex, age, race/ethnicity, annual household income, and urban/rural residence. We used the working clinical diagnoses of VA clinicians as recorded in the electronic medical record, and we clustered them together in our analysis as dementia, schizophrenia, major depression, bipolar disorder, posttraumatic stress disorder (PTSD), any anxiety disorder

(excluding PTSD), alcohol and other drug use disorders, and any personality disorder. We classified veteran service–connected disability status into 3 groups: not service-connected, service-connected with less than 50% disability, and service-connected with 50% or greater disability. We documented urban/rural status using zip codes and the Rural-Urban Commuting Area Codes developed in 1998 at the University of Washington (25), which allowed us to identify veterans residing in large urban areas, midsize communities, small communities, or isolated rural communities.

Data analysis

In bivariate comparisons of veterans with a nicotine dependence diagnosis and veterans without the diaganosis, we tested the significance of group differences using χ^2 tests and calculated odds ratios with 95% confidence intervals. Subsequently, we used logistic regression to identify risk factors and protective factors independently associated with nicotine dependence. We dummy coded variables representing race/ethnicity, urban/rural residence, service-connected disability status, and annual income, with reference categories representing other race/ethnicity, urban location, non–service connected, and incomes less than $7,000, respectively. We conducted subgroup analyses on homeless veterans and OIF/OEF veterans. Again, we used logistic regression to identify risk factors and protective factors independently associated with nicotine dependence within each subgroup. We set the level of significance for all analyses at $P < .01$, and all analyses were performed using SAS for Windows, version 9.2 (SAS Institute, Inc, Cary, North Carolina).

Results

Bivariate analyses of all VA health service users

Of all VA health service users in FY 2009, 749,353 (14.9%) received a nicotine dependence diagnosis (Table 1). In bivariate analyses, being male, black, having served in OEF/OIF, being aged 40 to 64 years, having an annual household income of $7,000 to $24,999, being service connected, and living in a rural area were significantly associated with nicotine dependence. Homeless veterans were almost 4 times as likely to receive a nicotine dependence diagnosis as veterans who were not homeless, and veterans who used mental health services were 2.5 times as likely to receive a nicotine dependence diagnosis than were veterans who did not use mental health services. Among mental health service users, 25.5% had a diagnosis of nicotine dependence.

The only protective factor among mental health diagnoses was having a diagnosis of dementia. Veterans who received any other mental health diagnoses (including schizophrenia, affective disorders, anxiety disorders, substance use disorders, and personality disorders) were significantly more likely to have a nicotine dependence diagnosis also. At greatest risk were veterans diagnosed with schizophrenia, an alcohol use disorder, a drug use disorder, or a personality disorder.

Multivariate analyses

All VA health service users

After controlling for other factors, veterans who were male, homeless, black, living in rural areas, using mental health services, and had an annual income of more than $7,000 were at increased risk for a nicotine dependence diagnosis independent of other factors (Table 2). OEF/OIF status, age, and being service-connected were found to be protective factors in this analysis. Again, dementia diagnosis was a protective factor, while all the other mental health diagnoses were risk factors, except that having a personality disorder was no longer significant. In particular, veterans who had an alcohol use disorder were more than 3 times as likely as veterans who did not to also have a nicotine dependence diagnosis.

Homeless veterans

We identified 120,234 (2.4%) homeless veterans. Among them, 47,252 (39.3%) received a diagnosis of nicotine dependence. Being male, living in a small or large rural area, having an income of $7,000 to $14,999, and being service-connected with less than 50% disability were significantly predictive of a nicotine dependence diagnosis (Table 3). As in the analysis of all VA health service users, having a diagnosis of dementia was a protective factor among homeless veterans, whereas having any other mental health diagnosis (except personality disorder) was a significant risk factor, particularly alcohol use disorder.

OEF/OIF veterans

Of the 200,300 (4.0%) veterans who served in OEF/OIF, 30,297 (15.1%) received a diagnosis of nicotine depen-

dence. Among OEF/OIF veterans, being male, homeless, and younger, living in a rural area, having income of $7,000 to $24,999, and using mental health services were significantly predictive of a nicotine dependence diagnosis (Table 3). OEF/OIF veterans who had a diagnosis of bipolar disorder, anxiety disorder, PTSD, alcohol use disorder, or drug use disorder were also at risk for nicotine dependence.

Discussion

We found that 15% of all veterans who used VA health services in FY 2009 received a diagnosis of nicotine dependence. Because we analyzed administrative data, we likely underestimated how many veterans actually have nicotine dependence; recent estimates indicate that 26% to 27% of veterans smoke (10,11). Although no previous study to our knowledge has examined the prevalence of nicotine dependence in the population of veterans using health services, our finding suggests nicotine dependence may be underdiagnosed and not adequately documented in VA administrative records. Because smoking is a leading cause of many chronic diseases and deaths (1), it may be beneficial for VA clinicians to better document nicotine use. The benefit of better documentation assumes that assessment and diagnosis lead to increased likelihood of successful intervention; various smoking cessation interventions are effective for veterans (5,26,27).

In identifying major risk factors, veterans who had mental health or substance use disorders were at significantly higher risk of receiving a nicotine dependence diagnosis than veterans who did not have such diagnoses. Among VA mental health service users, one-fourth had a nicotine dependence diagnosis. This result is consistent with previous findings of increased rates of nicotine use among adults with mental illness or substance use disorders in the general population (12-14).

Having an alcohol use disorder was the strongest independent predictor of a nicotine dependence diagnosis, followed closely by a drug use disorder. Veterans who had an alcohol use disorder were more than 3 times as likely and veterans with a drug use disorder were almost 2 times as likely to receive a nicotine dependence diagnosis compared to veterans without such disorders and controlling for other influential factors. VA clinicians may need to pay particular attention to smoking behaviors among veterans with mental illness or substance use disorders, especially because nicotine dependence disproportionately reduces the quality and length of life of people with these disorders in the general population (28). Providing smoking prevention and cessation interventions with other substance abuse and mental health treatment for veterans may be useful; efforts to integrate nicotine cessation programs into VA mental health services have shown some success (5).

Homeless veterans were also at increased risk for nicotine dependence diagnosis (39%), independent of their increased risk for addictive disorders. This finding is consistent with recent studies, which have found that 69% to 73% of homeless people in the general population smoke (29,30). Interestingly, these studies also found that more than one-third of homeless smokers expressed a readiness to quit and more than half received advice to quit from their health care providers, but they were still less likely to quit compared to others in the general population. People with multiple episodes of homelessness were less likely to quit (29). Besides alcohol and drug use as factors associated with smoking in the homeless population, studies have also found out-of-home placement in childhood, victimization while homeless, and smoking intiation at an earlier age are significant factors (29,31). There has been little development of smoking prevention and cessation programs for homeless people, let alone homeless veterans, and more research is needed in this area.

OEF/OIF status was protective against nicotine dependence diagnosis, in contrast to previous studies, which relied on self-report (6). It is worth reiterating that we did not examine nicotine dependence, per se, but rather how often it was diagnosed, which may explain the difference in findings and suggests nicotine dependence is not adequately assessed among OEF/OIF veterans, who are likely seeking treatment for more pressing health issues. We found that 15% of OEF/OIF veterans who received VA health services in FY 2009 received a nicotine dependence diagnosis. Substance use disorders were still significant risk factors, but OEF/OIF status alone did not increase risk for a nicotine dependence diagnosis. Among both OEF/OIF and homeless veterans, we consistently found that veterans who were male, low-income, and living in a rural area were at higher risk of receiving a nicotine dependence diagnosis. Dementia was found to be a protective factor, which may be because of its effects on general life functioning and behaviors, including smoking.

This study has several limitations. Administrative records are not always complete or reliable. VA clinicians may have

neglected to document nicotine dependence in the face of presenting primary diagnoses, which only illustrates the importance for VA clinicians to conduct comprehensive assessments of patients that include questions about smoking behaviors. We focused on identifying risk factors of a clinical diagnosis of nicotine dependence, which may be different from factors related to actual nicotine dependence. There may also be other correlates of nicotine dependence that we did not address in our analyses, such as certain medical conditions and unmeasured individual characteristics. Given our large sample size, analyses were sensitive to statistical significance, so we focused on odds ratios to identify major risk factors. Although we identified some correlates for nicotine dependence among veterans, we could not examine the causal pathways through which these factors increase risk because our data were cross-sectional. Future research and development of assessment, documentation, and interventions in this area are needed.

Our results suggest veterans are underdiagnosed for nicotine dependence and that better assessment and documentation methods are needed in the VA health system. Veterans who are homeless, have a mental illness, or have a substance use disorder may be particularly vulnerable to dependence on nicotine, and targeted outreach and intervention for these groups may be needed. This study may contribute to improved targeting of smokng prevention and cessation efforts in the VA health care system.

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Tables

Table 1. Bivariate Analysis of Demographic Characteristics, Health Service Use, and Mental Health Diagnoses With Nicotine Dependence Among Veterans,[a] 2008-2009

Characteristic/Use/Diagnosis	All VA Service Users, n (%) (N 5,031,381)	VA Service Users With Nicotine Dependence, n (%) (n 749,353)	Likelihood of Being Diagnosed With Nicotine Dependence, OR (95% CI)[b]
Sex			
Male	4,745,729 (94.3)	708,256 (14.9)	1.0 (1.0-1.1)
Female	285,652 (5.7)	41,097 (14.4)	1 [Reference]
Veteran status			
OIF/OEF	200,300 (4.0)	30,297 (15.1)	1.0 (1.0-1.0)
Other war eras	4,831,081 (96.0)	719,056 (14.9)	1 [Reference]
Homeless status			
Homeless	120,234 (2.4)	47,252 (39.3)	3.9 (3.8-3.9)
Not homeless	4,911,147 (97.6)	702,101 (14.3)	1 [Reference]
Age, y[b]			
<40	548,827 (10.0)	77,549 (14.1)	0.9 (0.9-0.9)
Not <40	4,482,554 (89.1)	671,804 (15.0)	1 [Reference]
40-49	474,444 (9.4)	99,805 (21.0)	1.6 (1.6-1.6)
Not 40-49	4,556,937 (90.6)	649,548 (14.3)	1 [Reference]
50-64	1,855,142 (36.9)	417,610 (22.5)	2.5 (2.5-2.5)
Not 50-64	3,176,239 (63.1)	331,743 (10.4)	1 [Reference]
65-74	931,971 (18.5)	107,565 (11.5)	0.7 (0.7-0.7)
Not 65-74	4,099,410 (81.6)	641,788 (15.7)	1 [Reference]
75-85	975,536 (19.4)	42,806 (4.4)	0.2 (0.2-0.2)
Not 75-85	4,055,845 (80.6)	706,547 (17.4)	1 [Reference]
>85	245,461 (4.9)	4018 (1.6)	0.1 (0.1-0.1)
Not >85	4,785,920 (95.1)	745,335 (15.6)	1 [Reference]
Race/ethnicity			
White/unknown	4,667,988 (92.8)	683,919 (14.6)	0.8 (0.8-0.8)
Not white/unknown	363,393 (7.2)	65,434 (18.0)	1 [Reference]
Black	269,618 (5.4)	54,278 (20.1)	1.5 (1.5-1.5)
Not black	4,761,763 (94.6)	695,075 (14.6)	1 [Reference]
Hispanic	101,633 (2.0)	12,271 (12.1)	0.8 (0.8-0.8)
Not Hispanic	4,929,748 (98.0)	737,082 (15.0)	1 [Reference]

Abbreviations: VA, Veterans Affairs; OR, odds ratio; CI, confidence interval; OEF/OIF, Operation Enduring Freedom/Operation Iraqi Freedom; PTSD, post-traumatic stress disorder.
[a] Among veterans who used the US Department of Veterans Affairs health system.
[b] OR for age represents odds with every increase of 10 years.
[c] Excludes PTSD.

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Table 1. (continued) Bivariate Analysis of Demographic Characteristics, Health Service Use, and Mental Health Diagnoses With Nicotine Dependence Among Veterans,[a] 2008-2009

Characteristic/Use/Diagnosis	All VA Service Users, n (%) (N 5,031,381)	VA Service Users With Nicotine Dependence, n (%) (n 749,353)	Likelihood of Being Diagnosed With Nicotine Dependence, OR (95% CI)[b]
Urban/rural residence			
Urban	3,403,266 (70.0)	492,611 (14.5)	0.7 (0.7-0.8)
Not urban	1,456,514 (28.9)	235,919 (16.2)	1 [Reference]
Large rural	596,785 (12.3)	96,631 (16.2)	1.3 (1.3-1.3)
Not large rural	4,755,606 (94.5)	631,899 (13.3)	1 [Reference]
Small rural	479,733 (9.9)	77,951 (16.2	1.3 (1.2-1.3)
Not small rural	4,872,658 (96.8)	650,579 (13.4)	1 [Reference]
Isolated rural	379,996 (7.8)	61,337 (16.1)	1.2 (1.2-1.3)
Not isolated rural	4,972,395 (98.8)	667,193 (13.4)	1 [Reference]
Annual income, $			
<7,000	1,684,080 (33.5)	224,110 (13.3)	0.8 (0.8-0.8)
Not <7,000	3,347,301 (66.5)	525,243 (15.7)	1 [Reference]
7,000-14,999	863,429 (17.2)	174,188 (20.2)	1.6 (1.6-1.6)
Not 7,000-14,999	4,167,952 (82.8)	575,165 (13.8)	1 [Reference]
15,000-24,999	620,426 (12.3)	101,087 (16.3)	1.1 (1.1-1.1)
Not 15,000-24,999	4,410,955 (87.7)	648,266 (14.7)	1 [Reference]
≥25,000	1,863,446 (37.0)	249,968 (13.4)	0.8 (0.8-0.8)
Not ≥25,000	3,167,935 (63.0)	499,385 (15.8)	1 [Reference]
Disability status			
Not service-connected	3,212,820 (63.8)	479,899 (14.9)	0.9 (0.9-0.9)
Service-connected	1,818,561 (36.1)	269,454 (14.8)	1 [Reference]
Service-connected, <50% disabled	943,456 (18.8)	128,361 (13.6)	1.0 (1.0-1.0)
Not service-connected, <50% disabled	4,567,824 (90.8)	620,992 (13.6)	1 [Reference]
Service-connected, ≥50% disabled	875,105 (17.4)	141,093 (16.1)	1.3 (1.3-1.3)
Not service-connected, ≥50% disabled	4,636,175 (92.1)	608,260 (13.1)	1 [Reference]
Mental health service use			
Any	1,102,846 (21.9)	281,266 (25.5)	2.5 (2.5-2.5)
None	3,928,535 (78.1)	468,087 (11.9)	1 [Reference]

Abbreviations: VA, Veterans Affairs; OR, odds ratio; CI, confidence interval; OEF/OIF, Operation Enduring Freedom/Operation Iraqi Freedom; PTSD, post-traumatic stress disorder.
[a] Among veterans who used the US Department of Veterans Affairs health system.
[b] OR for age represents odds with every increase of 10 years.
[c] Excludes PTSD.

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Table 1. (continued) Bivariate Analysis of Demographic Characteristics, Health Service Use, and Mental Health Diagnoses With Nicotine Dependence Among Veterans,[a] 2008-2009

Characteristic/Use/Diagnosis	All VA Service Users, n (%) (N 5,031,381)	VA Service Users With Nicotine Dependence, n (%) (n 749,353)	Likelihood of Being Diagnosed With Nicotine Dependence, OR (95% CI)[b]
Mental health diagnosis			
Dementia	58,157 (1.2)	3,226 (5.6)	0.3 (0.3-0.3)
No dementia	4,973,224 (98.8)	746,127 (15.0)	1 [Reference]
Schizophrenia	91,228 (1.8)	30,916 (33.4)	3.0 (3.0-3.1)
No schizophrenia	4,940,153 (98.2)	718,437 (14.5)	1 [Reference]
Bipolar disorder	102,636 (2.0)	32,608 (31.8)	2.7 (2.7-2.8)
No bipolar disorder	4,928,745 (98.0)	716,745 (14.5)	1 [Reference]
Major depression	251,560 (5.0)	64,732 (25.7)	2.1 (2.1-2.1)
No major depression	4,779,821 (95.0)	684,621 (14.3)	1 [Reference]
Anxiety disorder[c]	365,270 (7.3)	87,406 (23.9)	1.9 (1.9-1.9)
No anxiety disorder	4,666,111 (92.7)	661,947 (14.2)	1 [Reference]
PTSD	494,202 (9.8)	118,495 (24.0)	2.0 (1.9-2.0)
No PTSD	4,537,179	630,858 (13.9)	1 [Reference]
Alcohol use disorder	301,214 (6.0)	138,495 (46.0)	5.7 (5.7-5.8)
No alcohol use disorder	4,730,167 (94.0)	610,858 (12.9)	1 [Reference]
Drug use disorder	196,268 (3.9)	91,249 (46.5)	5.5 (5.5-5.6)
No drug use disorder	4,835,113 (96.1)	658,104 (13.6)	1 [Reference]
Personality disorder	43,176 (0.9)	14,869 (34.4)	3.0 (3.0-3.1)
No personality disorder	4,988,205 (99.1)	734,484 (14.7)	1 [Reference]

Abbreviations: VA, Veterans Affairs; OR, odds ratio; CI, confidence interval; OEF/OIF, Operation Enduring Freedom/Operation Iraqi Freedom; PTSD, post-traumatic stress disorder.
[a] Among veterans who used the US Department of Veterans Affairs health system.
[b] OR for age represents odds with every increase of 10 years.
[c] Excludes PTSD.

Table 2. Association of Demographic Characteristics, Health Service Use, and Mental Health Diagnoses With Nicotine Dependence Among Veterans,[a] 2008-2009

Characteristic/Use/Diagnosis	Likelihood of Nicotine Dependence Diagnosis	
	OR (95% CI)[b] (n 749,535)	*P* Value[c]
Sex		
Female	1 [Reference]	NA
Male	1.5 (1.5-1.5)	<.001
Veteran status		
Other war eras	1 [Reference]	NA
OIF/OEF	0.4 (0.4-0.5)	<.001
Homeless status		
Not homeless	1 [Reference]	NA
Homeless	1.2 (1.1-1.2)	<.001
Age[d]	0.8 (0.8-0.8)	<.001
Race/ethnicity		
Other	1 [Reference]	NA
White/unknown	1.1 (1.0-1.3)	.006
Black	1.3 (1.2-1.4)	<.001
Hispanic	0.8 (0.8-0.9)	<.001
Urban/rural residence		
Urban	1 [Reference]	NA
Large rural	1.3 (1.3-1.3)	<.001
Small rural	1.3 (1.3-1.3)	<.001
Isolated rural	1.4 (1.3-1.4)	<.001
Annual income, $		
<7,000	1 [Reference]	NA
7,000-14,999	1.5 (1.5-1.6)	<.001
15,000-24,999	1.3 (1.3-1.3)	<.001
≥25,000	1.1 (1.1-1.1)	<.001
Disability status		
Not service-connected	1 [Reference]	NA
Service-connected, <50% disabled	0.8 (0.8-0.8)	<.001
Service-connected, ≥50% disabled	0.8 (0.8-0.8)	<.001
Mental health service use		
None	1 [Reference]	NA
Any	1.3 (1.3-1.3)	<.001
Mental health diagnosis		
Not having the diagnosis	1 [Reference]	NA
Dementia	0.5 (0.5-0.6)	<.001
Schizophrenia	1.8 (1.7-1.8)	<.001
Bipolar disorder	1.2 (1.2-1.2)	<.001
Major depression	1.1 (1.0-1.1)	<.001
Anxiety disorder[e]	1.1 (1.1-1.1)	<.001
PTSD	1.2 (1.2-1.2)	<.001
Alcohol use disorder	3.2 (3.1-3.2)	<.001
Drug use disorder	1.8 (1.8-1.9)	<.001
Personality disorder	1.0 (1.0-1.0)	.03

Abbreviations: OR, odds ratio; CI, confidence interval; OEF/OIF, Operation Enduring Freedom/Operation Iraqi Freedom; NA, not applicable; PTSD, post-traumatic stress disorder.

[a] Among veterans for whom nicotine dependence diagnosis was documented in administrative records of the US Department of Veterans Affairs (VA) health system.

[b] Veterans with nicotine dependence represent 14.9% of all VA health system users (N = 5,031,381).

[c] Calculated by using the χ^2 test.

[d] OR for age represents odds with every increase of 10 years.

[e] Excludes PTSD.

Table 3. Association of Demographic Characteristics, Health Service Use, and Mental Health Diagnoses With Nicotine Dependence Among Subpopulations of Veterans (n = 749,353),[a] 2008-2009

Characteristic/Use/Diagnosis	Likelihood of Nicotine Dependence Diagnosis			
	Homeless Veterans, OR (95% CI) (n 47,252)[b]	*P* Value[c]	OEF/OIF Veterans, OR (95% CI) (n 30,297)[d]	*P* Value[c]
Sex				
Female	1 [Reference]	NA	1 [Reference]	NA
Male	1.2 (1.1-1.2)	<.001	1.4 (1.3-1.4)	<.001
Veteran status				
Other war eras	1 [Reference]	NA	1 [Reference]	NA
OEF/OIF	0.8 (0.7-0.8)	<.001	NA	NC
Homeless status				
Not homeless	NA	NC	1 [Reference]	NA
Homeless	NA	NC	1.3 (1.2-1.4)	<.001
Age[e]	1.0 (1.0-1.0)	.24	1.0 (1.0-1.0)	<.001
Race/ethnicity				
Other	1 [Reference]	NA	1 [Reference]	NA
White/unknown	1.2 (0.9-1.7)	.22	0.6 (0.1-4.5)	.59
Black	1.2 (0.8-1.6)	.41	0.5 (0.1-4.3)	.57
Hispanic	0.9 (0.6-1.2)	.36	0.3 (0.0-2.3)	.25
Urban/rural residence				
Urban	1 [Reference]	NA	1 [Reference]	NA
Large rural	1.2 (1.1-1.2)	<.001	1.4 (1.4-1.5)	<.001
Small rural	1.2 (1.1-1.3)	<.001	1.5 (1.5-1.6)	<.001
Isolated rural	1.1 (1.0-1.2)	.01	1.5 (1.5-1.6)	<.001
Annual income, $				
<7,000	1 [Reference]	NA	1 [Reference]	NA
7,000-14,999	1.1 (1.1-1.1)	<.001	1.1 (1.1-1.2)	<.001
15,000-24,999	1.0 (1.0-1.1)	.66	1.1 (1.0-1.1)	<.001
≥25,000	1.0 (0.9 (1.0)	.28	1.0 (1.0-1.0)	.99

Abbreviations: OR, odds ratio; CI, confidence interval; OEF/OIF, Operation Enduring Freedom/Operation Iraqi Freedom; NA, not applicable; NC, not calculated; PTSD, post-traumatic stress disorder.

[a] Among veterans for whom nicotine dependence diagnosis was documented in administrative records of the US Department of Veterans Affairs (VA) health system.

[b] Represents 39.3% of all homeless VA health system users (n = 120,234).

[c] Calculated by using the χ^2 test.

[d] Represents 15.1% of all OEF/OIF VA health system users (n = 200,300).

[e] OR for age represents odds with every increase of 10 years.

[f] Excludes PTSD.

(Continued on next page)

Table 3. (continued) Association of Demographic Characteristics, Health Service Use, and Mental Health Diagnoses With Nicotine Dependence Among Subpopulations of Veterans (n = 749,353),[a] 2008-2009

Characteristic/Use/Diagnosis	Likelihood of Nicotine Dependence Diagnosis			
	Homeless Veterans, OR (95% CI) (n 47,252)[b]	*P* Value[c]	OEF/OIF Veterans, OR (95% CI) (n 30,297)[d]	*P* Value[c]
Disability status				
Not service-connected	1 [Reference]	NA	1 [Reference]	NA
Service-connected, <50% disabled	0.9 (0.9-1.0)	.004	1.0 (0.9-1.0)	.004
Service-connected, ≥50% disabled	1.0 (0.9-1.0)	.12	0.9 (0.9-0.9)	<.001
Mental health service use				
None	1 [Reference]	NA	1 [Reference]	NA
Any	1.1 (1.0-1.1)	.01	1.3 (1.2-1.3)	<.001
Mental health diagnosis				
Not having the diagnosis	1 [Reference]	NA	1 [Reference]	NA
Dementia	0.7 (0.5-0.8)	<.001	0.9 (0.4-1.9)	.77
Schizophrenia	1.3 (1.2-1.3)	<.001	1.2 (1.0-1.4)	.01
Bipolar disorder	1.1 (1.1-1.2)	<.001	1.3 (1.2-1.4)	<.001
Major depression	1.2 (1.1-1.2)	<.001	1.0 (1.0-1.1)	.06
Anxiety disorder[f]	1.1 (1.1-1.2)	<.001	1.3 (1.2-1.3)	<.001
PTSD	1.2 (1.1-1.2)	<.001	1.3 (1.3-1.4)	<.001
Alcohol use disorder	2.1 (2.0-2.1)	<.001	2.3 (2.2-2.4)	<.001
Drug use disorder	1.9 (1.9-2.0)	<.001	2.0 (1.9-2.1)	<.001
Personality disorder	1.1 (1.0-1.1)	.02	1.1 (1.0-1.3)	.01

Abbreviations: OR, odds ratio; CI, confidence interval; OEF/OIF, Operation Enduring Freedom/Operation Iraqi Freedom; NA, not applicable; NC, not calculated; PTSD, post-traumatic stress disorder.
[a] Among veterans for whom nicotine dependence diagnosis was documented in administrative records of the US Department of Veterans Affairs (VA) health system.
[b] Represents 39.3% of all homeless VA health system users (n = 120,234).
[c] Calculated by using the χ^2 test.
[d] Represents 15.1% of all OEF/OIF VA health system users (n = 200,300).
[e] OR for age represents odds with every increase of 10 years.
[f] Excludes PTSD.

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ESSAY

Disease and Illness: Prevention, Treatment, Caring, and Health

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Disease is neither the starting point nor the end point of illness. It is a pathological process that may not be discovered until decades after the identification of an illness. Pathologists are the experts in "disease." Patients have illness. The disease process may have little obvious connection to the treatment for a patient. For example, strep throat has never been thought of as a penicillin deficiency, yet patients can imagine, just as insulin replaces a deficiency, perhaps penicillin may do the same.

What defines a disease? In the article by Tsai et al (1), nicotine dependence is highlighted as an important and often overlooked disease of veterans. Certainly, the administrative records of the US Department of Veterans Affairs health system underestimate the prevalence of nicotine dependence, but even so, the risk factors identified by Tsai et al improve our understanding of possible prevention and cessation interventions. Mental illness, substance abuse, and homelessness are major problems for which targeted interventions may reduce nicotine dependence. We also know that in the face of disasters — and war is just one type of disaster — smoking increases, further supporting that stress and nicotine use are closely tied (2,3). In fact, post disasters as well as after stressful encounters such as combat, smoking cessation interventions may be one of the best ways to identify both those who may benefit from smoking cessation programs and those with posttraumatic stress disorder (PTSD).

Nicotine dependence and chronic diseases are "illnesses" because they require treatment in a particular person. Treatment targets the disorder, the symptoms, the impairments in physical and psychosocial functioning, disabilities, comorbidities, and the trajectory of the illness. Each of these is a target for both prevention and treatment. Only by addressing all of these areas is an illness treated.

Health risk behaviors — such as smoking — are a particularly important target for treatment and medical intervention. Such interventions must address all stages of the disease and illness and include treatment, prevention, and caring (4). For example, asking for help is a behavior necessary for seeking care. Teaching soldiers how to ask for help and encouraging family members to intervene on their behalf can bring a disease to medical attention before it becomes a chronic illness. Similarly, teaching prevention behaviors such as not smoking or wearing a seatbelt can prevent diseases such as nicotine dependence/addiction (aka smoking) and PTSD, which is many times more likely from injuries sustained in a motor vehicle accident.

The trajectory of illness is a target for treatment and intervention in itself. Preventing chronicity, anticipating relapse, and changing interventions in the recovery stage versus the onset stage are all processes of considering the trajectory in a treatment and prevention plan. Targeting the trajectory of a disorder for intervention — for example, multiple sclerosis, myocardial infarction, depression, or smoking — means being aware of the difference between symptoms in the early-onset phase, mid phase, and chronic phase of the illness. It also means recognizing the predictors of these phases and adapting treatment to the phases, including a transient illness, a relapsing illness, or a chronic illness, all of which may be present in a single patient over time. The importance of treatment and prevention strategies in the recovery and rehabilitation phases of illness and disease is often forgotten in modern medicine; we send the patient home or fail to arrange follow-up care when the illness appears to be under control. The phases of the disease each have specific pathology that is important for intervention and prevention.

Let's consider a broken arm. Perhaps the broken arm is the second injury. The first was a bruise when the 8-year-old fell out of the tree, playing while his parents were away. It was only with the second fall, when he had climbed even higher, that he broke his arm. If he got to medical care, the bone may have been set, healed well with recovery and restoration of function. But if not, perhaps he hid the injury for several days because of shame and embarrassment, the bone did not set well. An injury has become a chronic impairment and perhaps a disability. The injury was preventable 1) by educating parents about attending to activities of their children even when they are away, 2) early detection of a bruise, 3) educating parents about shame and embarrassment in children who wish to please, or 4) educating the young boy how to manage shame and embarrassment so it does not affect his seeking care.

Example too simple? Apply the same to myocardial infarction, beginning with mild chest pain that was ignored. Or smoking, followed by cough, blood in the sputum, and a positive x-ray.

Our treatments must span the course of disease and illness and must precede the onset to gain opportunities for universal, selective, and targeted interventions for primary, secondary, and tertiary prevention (5).

So let's return to veterans and nicotine addiction. Rates of smoking increase with combat exposure (6). Depression, PTSD, and other psychiatric disorders are closely linked to smoking. We now have further information from Tsai et al that homelessness is also a risk factor. Screening for PTSD and depression after combat exposure and programs to facilitate employment and prevent homelessness are thus well supported for future trials to reduce nicotine addiction. Such programs are part of treating, preventing, and caring.

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