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Gender Differences in Demographic and Health Characteristics of the Million Veteran Program Cohort

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Abstract

Background: The Department of Veterans Affairs (VA) Million Veteran Program (MVP) is the largest ongoing cohort program of its kind with 654,903 enrollees as of June 2018. The objectives of this study were to examine gender differences in the MVP cohort with respect to response and enrollment rates; demographic, health, and healthcare characteristics; and prevalence of self-reported health conditions.

Method: The MVP Baseline Survey was completed by 415,694 Veterans (8% women), providing self-report measures of demographic characteristics, health status, and medical history.

Results: Relative to men, women demonstrated a higher positive responder rate (23.0% vs. 16.0%), slightly higher enrollment rate (13.5% vs. 12.9%), and among enrollees, a lower survey completion rate (59.7% vs. 63.8%). Women were younger, more racially diverse, had higher educational attainment, and were less likely to be married or cohabitating with a partner than men. Women were more likely to report good-to-excellent health status but poorer physical fitness, and less likely to report lifetime smoking and drinking than men. Compared to men, women Veterans showed increased prevalence of musculoskeletal conditions, thyroid problems, gastrointestinal

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conditions, migraine headaches, and mental health disorders and reduced prevalence of gout, cardiovascular diseases, high cholesterol, diabetes, and hearing problems.

Conclusions: Results revealed some substantial gender differences in the research participation rates, demographic profile, health characteristics, and prevalence of health conditions for Veterans in the MVP cohort. Findings highlight the need for tailoring recruitment efforts to ensure representation of the increasing women Veteran population receiving care through the Veterans Health Administration (VHA).

Keywords

Million Veteran Program; gender differences; mental health; physical health; women

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Between 2005 and 2015, the Veterans Health Administration (VHA) experienced nearly a two-fold increase (92%) in the number of women Veterans accessing care, outpacing the growth of male Veterans (U.S. Department of Veterans Affairs (VA), 2017). Women now make up approximately 7.5% of all VHA users (FY15 estimate; Frayne et al., 2018) and 8.7% of the total living U.S. Veteran population (2016 estimate; U.S. Department of Veterans Affairs, 2018); by 2040, women are projected to comprise approximately 16% of all living Veterans (U.S. Department of Veterans Affairs, 2017), representing the fastest growing Veteran group. Although women have historically underused VHA services (Murdoch et al., 2006), VA has made access to and improved quality of care for women Veterans a top priority during the past two decades (Carden, 2010; Frayne et al., 2014).

VA's commitment to ensuring equitable access to high-quality healthcare for women Veterans has stimulated a surge in research on women Veterans' health and healthcare issues (Bastian, Bosworth, Washington, & Yano, 2013; Yano et al., 2011). A review of women Veterans' health research published between 2004 and 2008 revealed that more articles were published within that 5-year period than during the 25 previous years (Bean-Mayberry et al., 2011); the pace of research increased further from 2008 through 2015 (Danan et al., 2017). Even with this growth, significant gaps remain, including failures to report gender-specific clinical findings (e.g., interventional trials including women Veterans but not reporting results by gender; see review by Danan et al., 2017) and a paucity of woman-focused clinical research (i.e. all-female samples or studies with a sufficient number of females to allow gender-specific analyses) on common diseases such as hypertension, diabetes, and depression despite their high prevalence among women Veterans. An explicit focus on sex/gender differences in clinical research can have far-reaching implications for understanding disease mechanisms, informing earlier detection of individuals at increased disease risk, and tailoring treatment planning. For example, there are not specific treatment guidelines for hypertension in women and men despite evidence of sex differences in mechanisms responsible for blood pressure control (Reckelhoff, 2018).

One major challenge involves difficulties in recruiting sufficient numbers of women Veterans for research that allows for adequate power to answer important clinical questions for this subgroup. Previous large-scale epidemiologic studies of Veterans' health typically included relatively small numbers of women even when this subgroup was purposely over-sampled (e.g., $n < 500$; Schlenger et al., 2015; Lehavot et al., 2018; Wisco et al., 2014). One

exception, the National Health Study for a New Generation of US Veterans (NewGen), a large-scale longitudinal study of post-9/11 Veterans' health, includes 4,346 women (Eber, Barth, Kang, Mahan, Dursa, & Schneiderman, 2013). Extant national studies comparing women Veterans and non-Veterans demonstrate that women Veterans reported poorer general health and greater prevalence of mental health and chronic health conditions, including depressive disorders, anxiety disorders, cardiovascular disease, and cancer (Lehavot et al., 2012; Levahot et al., 2018). Previous studies also suggest that women Veterans exhibited more mental health and other health concerns than male Veterans (Lehavot et al., 2018; Runnals et al., 2014; Ziobrowski et al., 2017). To date, the most comprehensive evaluation of gender differences in mental and physical health conditions was conducted by Ziobrowski et al. (2017) using a cross-sectional, nationally representative sample of U.S. Veterans (N = 3,157; n = 321 women). They found women Veterans had higher prevalence of lifetime posttraumatic stress disorder (PTSD) and major depressive disorders, arthritis, migraine headaches, and osteoporosis than men. Finally, there is evidence that women Veterans using VHA face unique challenges including worse physical and mental health, and poorer social and financial support than those who do not (Dursa, Barth, Bossarte, & Schneiderman, 2016; Runnals et al., 2014; Washington et al., 2015). Collectively, this body of work provides important insights into women Veteran's health, but previous military and Veteran cohorts often have been underpowered to examine gender differences in military service experiences and health outcomes or limited to specific service eras (e.g., Eber et al., 2013).

The VA Million Veteran Program (MVP) is an ongoing cohort program designed to integrate biochemical (including genetic) data, health record data, and self-reported health, lifestyle, and military exposure information. With over 725,000 enrollees (as of January 2019), representing all service eras, MVP is the largest genetic research cohort of its kind. MVP has employed various recruitment strategies designed to enhance enrollment and representativeness of the cohort, including efforts to increase enrollment of women through partnerships with women Veteran groups. For example, in March 2017 the Women's Health Research Network assisted with a mailing to women Veterans during Women's History Month. The 15,000 women selected for this pilot had already received MVP invitations. Rather than receiving additional invitations, a mailing acknowledging Women's History Month and the importance of female representation in MVP was distributed. The comparison group included women who received the standard additional MVP mailing. The enrollment rate among women who received the Women's History Month mailing was approximately 10% compared to 6% of women who received the standard mailings suggesting that efforts tailored toward women may result in higher enrollment rates among female Veterans. With continued recruitment underway, understanding the demographic and health characteristics of the MVP cohort is essential to ensure representation of the VHA population.

The primary aims of this paper include: 1) examining MVP response and enrollment rates by gender to determine the need for focused recruitment methods to augment enrollment of women; 2) describing demographic, health, and healthcare characteristics of MVP stratified by gender; and 3) evaluating gender differences in the prevalence of self-reported health conditions among MVP enrollees.

Methods

Study Design and Population

The VA Central Institutional Review Board (IRB) approved the MVP protocol in 2010 and enrollment began in 2011. At the time of this investigation, only Veterans who use the VHA were eligible for MVP enrollment. To date, over 4 million (91.8% male and 8.2% female) have been asked to join MVP. VHA users are recruited through direct (invitation mailings) and indirect (promotional materials) methods. Veterans may respond to invitation letters through various methods such as completion of the MVP Baseline Survey to schedule a visit (prior to enrollment), contacting the MVP Information Center to schedule a visit, or by "walking-in" to MVP facilities without scheduled visits. At the time of the visit, participants may enroll by undergoing an informed consent and HIPAA authorization process and provision of a blood specimen for storage in a VA Central Biorepository. Following enrollment, participants are asked to complete the MVP Baseline (if not already completed) and Lifestyle Surveys. Details on the design of MVP (including recruitment procedures) have been previously described (Gaziano et al., 2016; Nguyen et al., 2018).

Mail Responses and Enrollment Rates.—For the current investigation, mail response and enrollment rates reported by gender include Veterans mailed invitations to participate in MVP. Mail response rates include positive, negative, and non-responses. *Positive responses* are defined as Veterans who 1) affirmatively respond to MVP mailings; 2) contact the toll-free MVP Information Center to schedule an MVP visit; or 3) enroll at an MVP location without a scheduled visit (following receipt of an invitational mailing). *Negative responses* are defined as Veterans who opt-out of MVP (via mail, telephone, or in-person). *Non-responders* include Veterans who have not responded to any MVP invitational mailings.

For this investigation, *mailed enrollees* ($n = 594,880$) are defined as Veterans invited to participate through MVP invitational mailings who provided informed consent and HIPAA authorization. *Non-mailed enrollees* ($n = 60,023$) refer to Veterans who participate in MVP without receiving mailed invitations. *Total enrollees* ($n = 654,903$ as of June 2018) include both mailed enrollees and non-mailed enrollees of whom 56,651 (8.7%) were women.

Survey Responses.—Since the MVP Baseline Survey may be completed prior to or after enrollment, survey completion rates are provided for total enrollees. For purposes of demographic and healthcare characteristics, only total enrollees with a completed MVP Baseline Survey ($n = 415,694$) and known gender and age were examined. The MVP Lifestyle Survey ($n = 286,649$) is described for all total enrollees following enrollment.

Measures

The complete MVP survey instruments can be found in the Supplementary Materials published with the Gaziano et al. (2016) article. In brief, the MVP surveys measure demographics, health status, medical history, lifestyle habits, military experience, and family history of specific illnesses. For the current analyses, all survey data were derived from the MVP Baseline Survey except for alcohol use and smoking status which were based on responses to both MVP surveys. For health status, physical fitness status, exercise frequency,

and VA and non-VA prescription medications, the reference time-period was "current." Participants rated their overall pain level on a scale from 0 to 10 during "the past week" (slightly modified version of the Numeric Rating Scale [NRS]) used as a screening tool in routine clinical care). We used standard cutoffs for the NRS to yield four categories of pain intensity: 0 (no pain), 1 to 3 (mild pain), 4 to 6 (moderate pain), and 7 to 10 (severe pain) (Tan, Jensen, Thornby, Rintala, & Anderson, 2008). Participants were asked whether they "have been diagnosed" with 75 specific health conditions; thus, the self-reported health conditions should be considered as lifetime ("ever") as opposed to current diagnoses. Alcohol consumption and smoking were assessed at the time of survey completion by asking about the participant's current and historical use. Participants were categorized as "never drinkers", "former drinkers", or "current drinkers" based on their responses to the question, "Do you drink alcohol?" (response options: "Yes, I currently drink alcohol"; "No, but I used to drink alcohol"; and "No, I have never drank alcohol"; see Song et al., 2018 for details). Participants were categorized as a "never", "former", or "current" smoker based on their responses to two questions, "In your lifetime, have you smoked a total of least 100 cigarettes?" (response options: yes/no), and if yes, "Do you currently smoke cigarettes?" (response options: yes/no). To assess the extent of VA healthcare utilization during the past year, participants were asked, "about how much of your health care did you get at a VA facility?" (response options: none, 1–25%, 26–50%, 51–75%, 76–99%, and 100%) and "how many times were you a patient in a [VA] hospital overnight or longer?" (response options: none, 1–3, 4–6, 7–9, 10 or more).

Data were obtained from the VA health records' Corporate Data Warehouse (CDW; Fihn et al., 2014) to supplement self-reported gender and age (date of birth) when missing from MVP Baseline Surveys (3.1% and 3.9% of enrollees, respectively). CDW data were also combined with self-reported race, ethnicity, and service era to provide a more complete demographic profile. For reporting response and enrollment rates on all eligible MVP participants by gender, CDW was the sole data source for gender.

Data Analysis

First, demographic, health, and healthcare characteristics, as well as self-reported health conditions for men were standardized to the age distribution of women who completed an MVP Baseline Survey using the direct standardization option of PROC STDRATE in SAS. When performing age standardization, age groups were stratified into 10-year increments (e.g., 30 to 39) except for the youngest (18 to 29) and oldest (90+) age groups. Second, to test if the age-standardized characteristics for men were significantly different from the unadjusted characteristics for women, we used the Cochran-Mantel-Haenszel test and a linear mixed model for frequencies and means, respectively. To evaluate gender differences in prevalence of self-reported health conditions, we estimated risk ratios and 95% confidence intervals using the age-standardized risk for men versus the unadjusted risk for women. Finally, we examined the top 20 self-reported health conditions for each gender and age strata. Age categories were defined as <45, 45–64 and 65 years of age based on the distribution of age for women VHA users and to allow for direct comparisons with the broader VHA population (cf. Frayne et al., 2018). All analyses were conducted using SAS 9.4.

Results

Mail Response and Enrollment Rates

Of the approximately 4.6 million Veterans who use the VHA contacted by MVP, 28.1% responded (16.5% positive and 11.6% negative). Figure 1 provides an overview of MVP recruitment efforts and enrollment rates by gender. Women Veterans had higher positive responder rates (23.0%) compared to men (16.0%), lower negative responder rates (7.3%) compared to men (12.0%), and lower non-responder rates (69.7%) compared to men (72.0%). The enrollment rate for invited MVP participants is 13.0%; women enrollees have a slightly higher enrollment rate of 13.5% compared to 12.9% for men. Increases in women enrollees have been observed since MVP launched in 2011 (7.7%) to 8.9% in 2016.

Survey Responses

Among the 654,903 total enrollees, 415,694 (63.8%) had a completed Baseline Survey and known gender and age. Among women total enrollees, 33,833 (59.7%) completed an MVP Baseline Survey compared to 381,861(63.8%) men total enrollees. Lower rates for completion of the MVP Lifestyle Survey were observed for both women (n = 22,153; 39.1%) and men (n = 264,496; 44.2%).

Demographic, Health, and Healthcare Characteristics

The mean age of MVP total enrollees with an MVP Baseline Survey was 64.70 (SD = 12.49); 8.1% were women and 74.7% were non-Hispanic White. Most women total enrollees were between 45 and 64 years old (58.9%) whereas the majority of men total enrollees were 65 or older (59.7%). Demographic characteristics are presented in Table 1, stratified by gender and adjusted for age. Compared with men, women were younger and more racially diverse, had higher educational attainment, and were less likely to be married or cohabitating with a partner. Women were less likely than men to be Hispanic and to have an annual household income of $60,000. A higher proportion of women served in more recent conflicts (post-Vietnam through Operation Enduring Freedom [OEF]/Operation Iraqi Freedom [OIF]/Operation New Dawn [OND]) compared to men. Women were more likely to serve in the Air Force and less likely to serve in the Marine Corps.

Self-reported health and healthcare characteristics are summarized in Table 2, stratified by gender and adjusted for age. Compared to age-standardized men, women were more likely to report good-to-excellent health status, but reported poorer current physical fitness including less frequent exercise. Women and men did not differ in the mean number of self-reported health conditions. Fewer women (57.3%) than men (60.7%) reported moderate or severe pain (NRS 4+). Women were more likely to be never smokers and never drinkers. Current smoking and current drinking were reported less frequently by women (19.4% and 54.0%, respectively) than men (25.3% and 56.1%, respectively). Among respondents, a higher proportion of women utilized the VHA system for more than half of their healthcare compared to men (73.0% and 69.8%, respectively), and women had fewer inpatient hospital stays than men (16.5% and 20.3%, respectively). Women were more likely to receive prescription medications from the VA compared to men.

Self-reported Health Conditions

Among the top self-reported diseases, 29 out of 33 diseases had a statistically significant difference between women and men in age-adjusted prevalence (see Supplemental Table 1). Figure 2 shows a forest plot of the age-standardized risk ratios (RR) and 95% confidence intervals for the 20 self-reported health conditions with the greatest disparities between women and men. Compared to men, women had an increased prevalence of osteoporosis, thyroid problems, irritable bowel syndrome, migraine headaches, osteoarthritis, asthma, bipolar disorder, anxiety reaction/panic disorder, depression, and other headaches (RRs = 1.38–4.23), and a reduced prevalence of gout, heart attack, coronary artery/heart disease, hearing loss, tinnitus, traumatic brain injury, sleep apnea, diabetes, hypertension, and skin cancer (RRs = 0.31–0.81).

Overall, the three most prevalent self-reported health conditions among women Veterans were depression, high cholesterol, and hypertension and among men were hypertension, high cholesterol, and tinnitus. The top five self-reported health conditions within each of the age and gender strata, comprising 12 total conditions, are displayed in Table 3. Among Veterans under age 45, depression, PTSD, and anxiety reaction/panic disorder were among the most common conditions (i.e., top 4) reported by both women and men. The top three conditions were the same for women and men Veterans between 45–64 years, but the prevalence rates varied considerably for women versus men: depression (50.1% vs. 35.8%), high cholesterol (46.6% vs. 54.8%), and hypertension (44.5% vs. 70.2%). Among Veterans 65 and older, this gender gap nearly closes such that women and men reported a similar prevalence of hypertension (65.1% and 70.2%) and high cholesterol (60.4% and 61.6%). Acid reflux/GERD was ranked fourth for both women and men ages 45–64 and a similar pattern persisted in Veterans 65 and older. Across the lifespan, migraine headaches and musculoskeletal problems were more commonly reported by women whereas hearing problems (tinnitus and hearing loss) were more prevalent in men.

Discussion

In the MVP cohort, women Veterans demonstrated a higher positive responder rate, lower negative responder rate, and slightly higher enrollment rate compared with men. These response and enrollment rates are consistent with research on participant demographic characteristics suggesting that women demonstrate higher participation rates than men (Galea & Tracy, 2007). MVP Baseline and Lifestyle Survey completion rates were somewhat lower for women than men which is not consistent with previous research demonstrating higher survey completion rates among women (Moore & Tarnai, 2002). While a goal of MVP is to enroll and collect self-reported data from as many Veterans as possible, future examination of the differences in response and completion rates by gender may enable better techniques for increased participation among various groups. For example, as MVP launches online data collection (in addition to paper-based surveys), we expect to observe higher survey completion rates for women VHA users given their younger age distribution and data demonstrating that the younger population has more access to the internet and increased smartphone use (Pew Research Center, 2018).

MVP has collaborated with various women Veteran groups in the VA to ensure representation and foster relationships. The Center for Women Veterans (CWV), established by Congress in 1994, coordinates VA's administration of care and programs for women Veterans and acts as an advocate in recognizing contributions of women Veterans. The CWV released several communications promoting MVP in the past few years. The Women's Health Research Network (WHRN), composed of the VA Women's Health Research Consortium and the VA Women's Health Practice-Based Research Network (WH-PBRN), funded by HSR&D in 2010 to enhance VA women's health services research studies (Yano et al., 2011), has promoted MVP across their network. Of the approximately 60 VA WH-PBRN facilities, 76% are or have been MVP sites.

As described in the introduction, the WHRN assisted with the informational MVP mailing geared toward women that was piloted among 15,000 eligible women for Women's History Month in 2017, yielding over a 10% enrollment rate. These results were promising given the content of the mailing was informational (as opposed to the standard MVP invitational materials) and suggest that further refinement of recruitment materials tailored to reach different sub-populations may increase response, enrollment, and survey completion rates. Further activities aimed at promoting women Veteran MVP enrollment have included posters featuring women Veterans displayed at MVP sites, women Veterans' fact sheets, and encouragement to MVP site staff to coordinate with their local Women Veterans Program Managers and Women's Health Coordinators. Following these efforts, MVP saw an increase in women Veteran enrollees from approximately 8% to almost 9% currently, with a goal of increasing to 11%.

With respect to age and gender distributions, Nguyen et al. (2018) previously demonstrated that MVP participants are representative of the broader VHA population. Our study extended this work by examining patterns of gender differences in core demographic characteristics of MVP participants. Consistent with the broader VHA population (Frayne et al., 2018; U.S. Dept. of Veterans Affairs, 2018), women Veterans in MVP were younger, more racially diverse (but less ethnically diverse), had higher educational attainment, and were less likely to be married or cohabitating with a partner.

The gender differences in health characteristics and healthcare utilization reported by MVP participants were generally reflective of the larger VHA population and supported by previous research. We found that women were more likely to report good-to-excellent health status than men, but poorer current physical fitness including less frequent exercise (Grossbard et al., 2013). In addition, a higher prevalence of obesity was previously observed among women relative to men enrolled in MVP (Nguyen et al., 2018). A lower proportion of women reported moderate and severe pain compared with age-standardized men. This finding was inconsistent with previous studies which have found that women were more likely than men to report moderate and severe pain, whereas men were more likely to report no pain (Haskell et al., 2009; Higgins et al., 2017). This discrepancy may be attributable to the older age of MVP participants and their relatively greater endorsement of clinically significant pain compared with the previous studies which included substantially fewer Veterans in the 65 and older category. Furthermore, these prior studies reported gender

differences in the raw frequencies of pain intensity without adjusting for age and our unadjusted results showed the same pattern as previous studies.

Women Veterans were more likely to be never smokers and never drinkers, and less likely to report current smoking and current drinking than men (Cypel et al. 2016; Ziobrowski et al., 2017). It is noteworthy that some other studies of VHA users have found that women Veterans were more likely to be current smokers than men (e.g., Farmer et al., 2011; Huang, Kim, Muz, & Gasper, 2018). This difference may be explained by the fact that rates of smoking decline with age, women Veterans are younger than men, and that these studies did not report the age-adjusted prevalence of smoking. In support of this hypothesis, the unadjusted prevalence of current smoking was higher among women MVP participants than men. Consistent with Frayne et al. (2018), we found that a higher proportion of women were predominantly using the VHA for healthcare needs. In addition, women were more likely to receive prescription medications from the VA and had fewer inpatient hospitalizations compared to men.

Although women and men did not differ in the mean number of self-reported health conditions, findings from this study highlight some substantial gender differences in the relative prevalence of specific health conditions for Veterans using the VHA system. Of the health conditions examined in this study, women Veterans showed increased prevalence of musculoskeletal conditions, thyroid problems, gastrointestinal conditions, migraine headaches, and mental health disorders and reduced prevalence of gout, cardiovascular diseases, high cholesterol, diabetes, and hearing problems. Overall, the prevalence rates were consistent with those reported by Frayne et al. (2018) which were based on VHA users in FY15. One notable gender difference which is supported by the literature is that depressive disorders, PTSD, and anxiety disorders are more prevalent among women compared with men across the lifespan (Frayne et al., 2018; Lehavot et al., 2018; Maguen et al., 2010; Runnals et al., 2014; Ziobrowski et al., 2017). Consistent with Frayne et al. (2018), depression was among the most commonly reported conditions by women Veterans across the lifespan; despite depression's high prevalence, Danan et al.'s (2017) review found only three studies including women Veterans with a primary focus on depression. In addition, women exhibited a substantially higher prevalence of osteoporosis, thyroid problems, irritable bowel syndrome, migraine headaches, osteoarthritis, and asthma (RRs: 1.9–4.2) which is comparable to findings from a nationally representative sample of U.S. Veterans (Ziobrowksi et al., 2017). Similar to Ziobrowski and colleagues, women Veterans showed a lower prevalence of cardiovascular diseases and diabetes relative to men, but these conditions were still endorsed at high levels in women >65 years (most notably, diabetes was reported by 25% of women over 65). Furthermore, women had similar prevalence of risk factors for heart disease (i.e. hypertension, high cholesterol) when comparing men and women within the same age strata (45–64 and 65+). The prevalence of hypertension and high cholesterol among women Veterans was strikingly high (>44% in women ages 45–64 and >60% in women ages 65 and older), consistent with previous studies (Vimalananda et al., 2013). Given the predominance of hypertension and diabetes observed in women Veterans, it is remarkable that Danan et al. (2017)'s review of women Veterans' health did not identify any published clinical research studies with a primary focus on hypertension and only three studies on diabetes that included women Veterans.

Implications for Practice and/or Policy

Results revealed some substantial gender differences in the research participation rates, demographic profile, health characteristics, and prevalence of health conditions for Veterans in the MVP cohort. Understanding the specific health characteristics and healthcare utilization patterns for women Veterans is an important first step for identifying potential targets for early screening and intervention on potentially modifiable risk factors. For example, women reported poorer physical fitness; less frequent exercise; higher likelihood of having mental health disorders, musculoskeletal conditions, thyroid problems, gastrointestinal conditions, and migraine headaches; higher prevalence of obesity; and greater utilization of the VHA system than men. These findings suggest the need for tailoring healthcare services and outreach efforts to meet the specific needs of women Veterans receiving care through the VHA. For example, behavioral health interventions (including promoting physical activity and weight loss, smoking cessation, and mental health services) may be adapted to best address women's needs and preferences (e.g., offering access to women only programs, same-gender providers, gender-specific treatment guidelines, gender-sensitive care; see deKleijn et al., 2015). Studies on gender-specific behavioral health services and preferences have shown that women Veterans reported strong preferences for having designated women's services for PTSD, depression, and coping with chronic medical conditions (Kimerling et al, 2015), as well as weight management (Goldstein et al., 2017).

Limitations and Directions for Future Research

Limitations of this research include the cross-sectional nature of the data in the self-reported surveys with limited data supplemented from CDW. Given that only 16.5% of participants contacted have responded positively and that not all enrollees have completed the MVP surveys, the potential for a non-representative sample is a limitation. Future efforts are focused on enhanced survey completion and validation of the surveys with data from CDW which will allow for examination of all MVP enrollees (regardless of survey completion). However, given the consistency between the self-reported health conditions and existing VA data (cf. Frayne et al., 2018 which identified diagnoses using *International Classification of Diseases* (*ICD)* codes), confidence in the self-report data is warranted.

As with most VA research, the discrepancy between the number of men and women Veterans is a limitation (addressed by utilizing age standardization in the analyses), however, the inherent strength of the volume of enrollees in MVP allowed us to examine subgroups of men and women with sufficient power to detect meaningful differences. Due to the large sample size of the MVP, we acknowledge that some of the statistically significant findings may not be clinically relevant. Given the descriptive nature of this research and the focus on characterizing the influence of gender and age health conditions in Veterans, we did not account for other potentially confounding variables that may contribute to gender differences (i.e. beyond adjustment for age) nor did we adjust for multiple comparisons. Finally, the findings may not generalize to Veterans who do not access VHA care. MVP is considering expansion to the entire Veteran population which may address this limitation in years to come.

Continued efforts to partner with women Veteran groups and tailoring of recruitment materials are underway to ensure MVP maintains generalizable representation of the drastically growing women Veteran population. As MVP implements different methods of outreach and enrollment (such as expansion to online enrollment), the ability to capture a wider array of women Veterans is promising. In conclusion, with the continued growing number of women enrollees, MVP represents a valuable resource with potential to advance the evidence base for a variety of diseases, and ultimately improve health outcomes and healthcare delivery for current and future generations of women Veterans.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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- Wm. Jennings Bryan Dorn VA Medical Center (Kathlyn Sue Haddock, Ph.D.)

- VA North Texas Health Care System (Sujata Bhushan, M.D.)

- Hampton VA Medical Center (Pran Iruvanti, Ph.D.)

- Hunter Holmes McGuire VA Medical Center (Michael Godschalk, M.D.)

- Iowa City VA Health Care System (Zuhair Ballas, M.D.)

- Jack C. Montgomery VA Medical Center (Malcolm Buford, M.D.)

- James A. Haley Veterans' Hospital (Stephen Mastorides, M.D.)

- Louisville VA Medical Center (Jon Klein, M.D.)

- Manchester VA Medical Center (Nora Ratcliffe, M.D.)

- Miami VA Health Care System (Hermes Florez, M.D.)

- Michael E. DeBakey VA Medical Center (Alan Swann, M.D.)

- Minneapolis VA Health Care System (Maureen Murdoch, M.D)

- N. FL/S. GA Veterans Health System (Peruvemba Sriram, M.D.)

- Northport VA Medical Center (Shing Shing Yeh, M.D.)

- Overton Brooks VA Medical Center (Ronald Washburn, M.D.)

- Philadelphia VA Medical Center (Darshana Jhala, M.D.)

- Phoenix VA Health Care System (Samuel Aguayo, M.D.)

- Portland VA Medical Center (David Cohen, M.D.)

- Providence VA Medical Center (Satish Sharma, M.D.)

- Richard Roudebush VA Medical Center (John Callaghan, M.D.)

- Salem VA Medical Center (Kris Ann Oursler, M.D.)

- San Francisco VA Health Care System (Mary Whooley, M.D.)

- South Texas Veterans Health Care System (Sunil Ahuja, M.D.)

- Southeast Louisiana Veterans Health Care System (Amparo Gutierrez,M.D.)

- Southern Arizona VA Health Care System (Ronald Schifman, M.D.)

- Sioux Falls VA Health Care System (Jennifer Greco, M.D.)

- St. Louis VA Health Care System (Michael Rauchman, M.D.)

- Syracuse VA Medical Center (Richard Servatius, Ph.D.)

- VA Eastern Kansas Health Care System (Mary Oehlert, Ph.D.)

- VA Greater Los Angeles Health Care System (Agnes Wallbom, M.D.)

- VA Loma Linda Healthcare System (Ronald Fernando, M.D.)

- VA Long Beach Healthcare System (Timothy Morgan, M.D.)

- VA Maine Healthcare System (Todd Stapley, D.O.)

- VA New York Harbor Healthcare System (Scott Sherman, M.D.)

- VA Pacific Islands Health Care System (Gwenevere Anderson, R.N.)

- VA Palo Alto Health Care System (Philip Tsao, Ph.D.)

- VA Pittsburgh Health Care System (Elif Sonel, M.D.)

- VA Puget Sound Health Care System (Edward Boyko, M.D.)

- VA Salt Lake City Health Care System (Laurence Meyer, M.D.)

- VA San Diego Healthcare System (Samir Gupta, M.D.)

- VA Southern Nevada Healthcare System (Joseph Fayad, M.D.)

- VA Tennessee Valley Healthcare System (Adriana Hung, M.D.)

- Washington DC VA Medical Center (Jack Lichy, M.D., Ph.D.)

- W.G. (Bill) Hefner VA Medical Center (Robin Hurley, M.D.)

- White River Junction VA Medical Center (Brooks Robey, M.D.)

- William S. Middleton Memorial Veterans Hospital (Robert Striker, M.D.)

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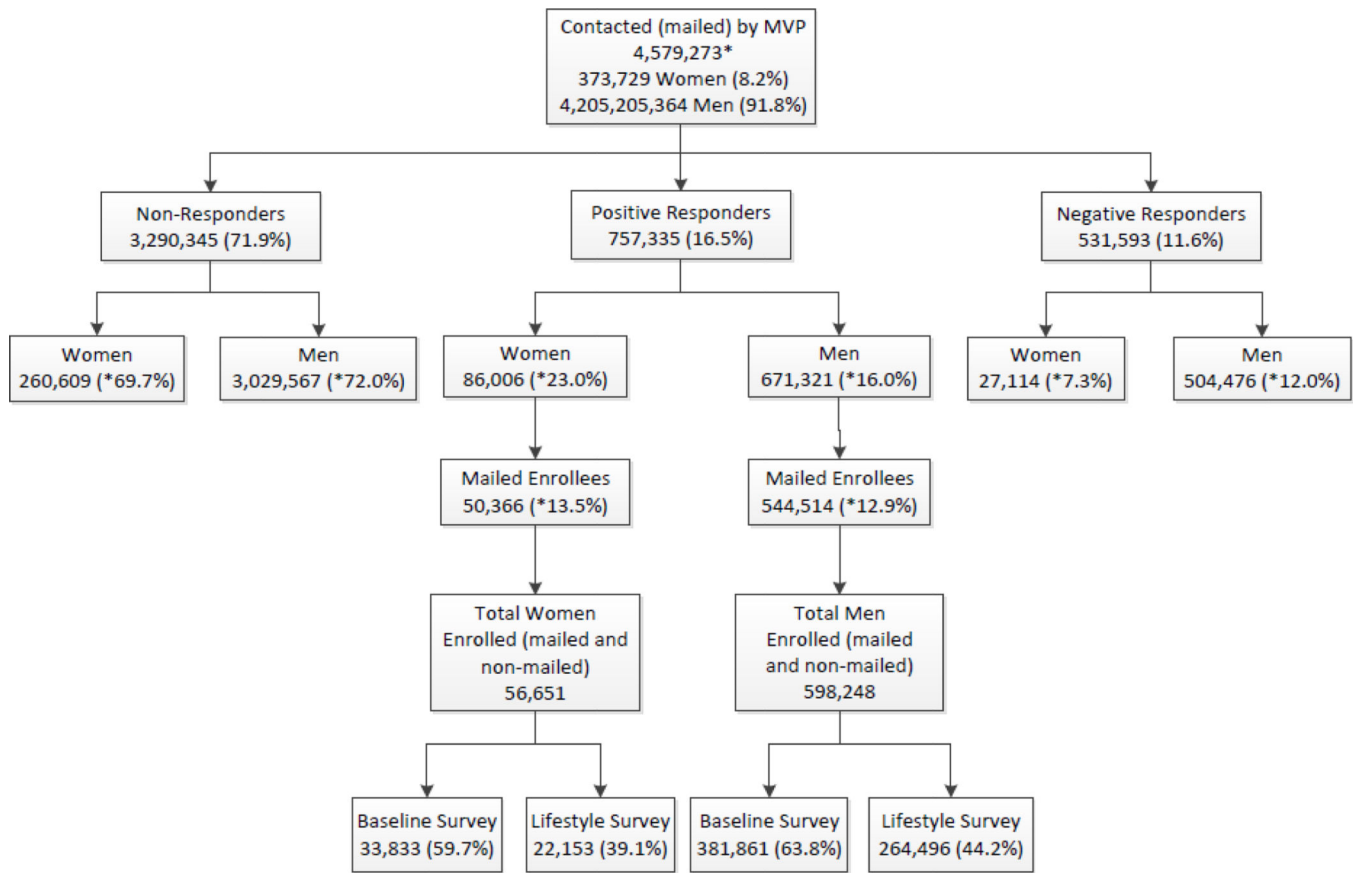
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Figure 1.
Flowchart of MVP recruitment efforts, enrollment rates, and survey completion rates by gender.
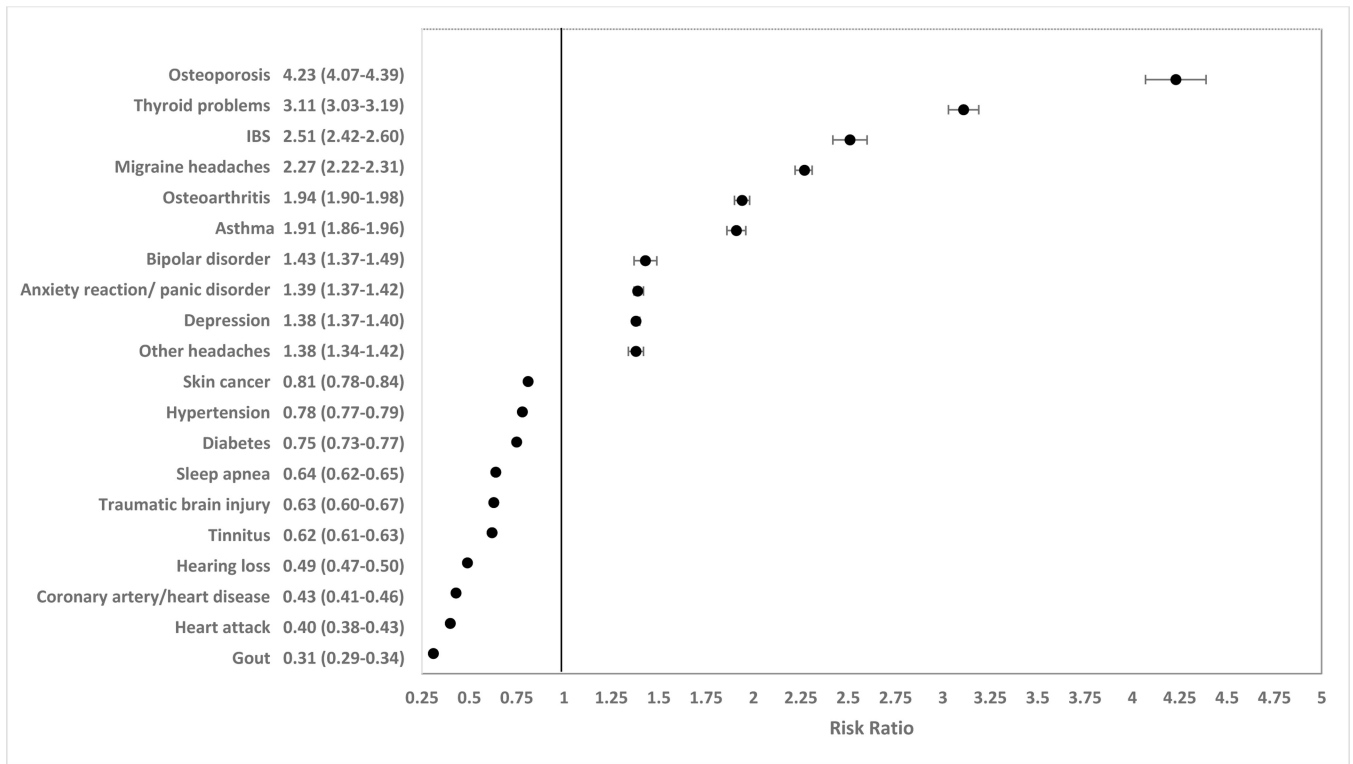
Figure 2.
Age-standardized risk ratios (RRs) and 95% confidence intervals of self-reported health conditions for women versus men enrolled in the MVP (using men as the reference group). This figure displays the top 10 conditions associated with elevated risk for women and the top 10 conditions associated with reduced risk for women (the 10 largest and 10 smallest RRs, respectively). IBS = Irritable Bowel Syndrome.

Table 1

Baseline Characteristics of Million Veterans Program Enrollees by Gender

Characteristic	Unadjusted		Age-Adjusted	
	Men (n = 381,861)[a]	Women (n = 33,833)[b]	Men (n = 381,861)[a]	
	% or M (SD)	% or M (SD)	% or M (SD)	p-value[c]
Age, years (M ± SD)	65.69 ± 11.93	53.45 ± 13.06		
Age category (%)				
18–45	5.4	23.9		
>45–64	34.9	58.9		
65	59.7	17.1		
Race[d] (%)				<.001
White	82.7	72.4	76.1	
Black	13.4	23.4	18.4	
Asian	1.2	2.2	2.2	
American Indian/Alaska Native	3.5	6.4	4.6	
Native Hawaiian/Pacific Islander	0.2	0.3	0.3	
Other	3.1	4.7	4.8	
Multiple	3.8	7.8	5.4	
Ethnicity, Hispanic (%)	5.3	6.3	8.0	<.001
Married or cohabitating with partner (%)	79.9	68.6	75.6	<.001
Education level, some college (%)	72.4	91.1	77.0	<.001
Annual household income (%)				.002
<$30,000	37.8	36.2	37.2	
$30,000–$59,999	35.0	34.1	32.0	
$60,000–$99,999	18.1	18.6	19.2	
$100,000	9.1	11.1	11.7	
Enrollment by region (%)				<.001
Midwest	18.3	14.1	16.6	
Northeast	16.1	14.2	15.5	
Southeast	31.2	34.3	31.7	

Characteristic	Unadjusted		Age-Adjusted	
	Men (n = 381,861)[a]	Women (n = 33,833)[b]	Men (n = 381,861)[a]	p-value[c]
	% or M (SD)	% or M (SD)	% or M (SD)	
Southwest	14.4	17.2	15.2	
West	20.0	20.1	21.0	
Service era[c] (%)				< .001
September 2001 or later	9.4	30.7	28.5	
August 1990 to August 2001 (includes Gulf War)	15.2	42.6	34.1	
May 1975 to July 1990	25.0	48.2	40.5	
August 1964 to April 1975 (Vietnam era)	55.7	21.1	32.8	
February 1955 to July 1964	15.9	4.0	4.6	
July 1950 to January 1955 (Korean War)	9.5	1.8	2.1	
January 1947 to June 1950	1.5	0.2	0.5	
December 1941 to December 1946 (WWII)	4.0	1.1	1.2	
November 1941 or earlier	0.2	0.0	0.1	
Branch of service (%)				< .001
Army	49.9	48.3	49.4	
Navy	22.2	22.2	22.2	
Air Force	17.3	23.3	15.1	
Marine Corps	11.8	6.0	14.1	

Note.

[a] Among men, missing data were as follows: race (n = 964), ethnicity (n = 1,982), marital status (n = 8,209), education (n = 6,155), income (n = 42,354), and region (n = 352).

[b] Among women, missing data were as follows: race (n = 104), ethnicity (n = 153), marital status (n = 601), education (n = 501), income (n = 3,430), and region (n = 57).

[c] Comparing age-adjusted men to women.

[d] Percentages sum to > 100% because multiple categories could be selected for race and service era.

Table 2

Health and Healthcare Characteristics of Million Veteran Program Enrollees by Gender

Characteristic	Unadjusted		Age-Adjusted	
	Men ($n = 381,861$)[a]	Women ($n = 33,833$)[b]	Men ($n = 381,861$)[a]	p-value[c]
	% or M (SD)	% or M (SD)	% or M (SD)	
Current health status (%)				< .001
Good - excellent	59.5	64.5	59.5	
Fair - poor	40.5	35.5	40.5	
No. health conditions, lifetime ($M \pm SD$)	7.95 ± 5.74	7.33 ± 5.19	7.36	−0.85
Current physical fitness status, self-rating (%)				< .001
Very good - fairly good	36.6	32.8	33.7	
Satisfactory	34.7	34.9	35.7	
Fairly poor – very poor	28.7	32.3	30.6	
Current exercise frequency (%)				< .001
<1–3 times/month	44.7	47.5	43.1	
Once/week	13.4	13.2	14.0	
2–4 times/week	28.0	28.4	28.9	
5 times/week	14.0	10.9	14.1	
Pain intensity, past week (%)				< .001
No pain (0)	11.8	10.5	9.7	
Mild pain (1–3)	36.5	32.2	29.6	
Moderate pain (4–6)	28.8	29.7	30.4	
Severe pain (7–10)	22.9	27.6	30.3	
Smoking status (%)				< .001
Never	25.2	46.4	32.2	
Former	56.1	34.2	42.4	
Current	18.8	19.4	25.3	
Alcohol use (%)				< .001
Never	7.6	11.2	6.3	
Former	39.4	34.8	37.6	

Characteristic	Unadjusted		Age-Adjusted	
	Men (n = 381,861)[a]	Women (n = 33,833)[b]	Men (n = 381,861)[a]	p-value[c]
	% or M (SD)	% or M (SD)	% or M (SD)	
Current	53.1	54.0	56.1	
VA healthcare use, past year (%)				<.001
None	7.9	6.4	8.1	
Less than half of care	26.2	20.6	22.1	
More than half of care	24.3	26.5	24.4	
All care	41.7	46.5	45.4	
VA inpatient hospital stays, past year (%)				<.001
None	79.3	83.5	79.7	
1–3	17.1	14.2	16.4	
4+	3.6	2.3	3.9	
Current Rx medications from VA (%)				<.001
None	14.7	14.2	17.4	
1–3	28.3	31.1	31.2	
4–6	27.5	26.1	25.7	
7+	29.6 / 28.6	25.7		
Current Rx medications outside VA (%)				<.001
None	33.1	43.6	57.5	59.7
1–3	15.3	29.2	26.5	
4–6	7.9	9.1	9.3	
7+		4.2	4.6	

Note. No. = number; VA = Department of Veterans Affairs; Rx = prescription.

[a] Missing data on health status for men: (n = 2,387), exercise (n = 6,348), alcohol use (n = 117,365), VA use (n = 7,383), VA hospital use (n = 54,720), VA Rx meds (n = 29,644), Non-VA Rx meds (n = 181,340).

[b] Missing data on health status for women: (n = 185), exercise (n = 440), alcohol use (n = 11,680), VA use (n = 419), VA hospital use (n = 3,071), VA Rx meds (n = 1,541), Non-VA Rx meds (n = 13,185).

[c] Comparing age-adjusted men to women.

Table 3

Prevalence of Top Self-Reported Health Conditions in MVP Enrollees Stratified by Gender and Age

Health conditions	Women (n = 33,833)			Men (n = 381,861)		
	< 45 years (n=8,094)	45–64 years (n=19,939)	65 years (n=5,800)	< 45 years (n=20,755)	45–64 years (n=133,135)	65 years (n=227,971)
	%	%	%	%	%	%
Neurologic						
Migraine headaches	39.7	30.2	15.6	19.8	11.9	5.3
Musculoskeletal						
Osteoarthritis	9.1	27.2	39.7	7.1	14.8	15.3
Other skeletal/muscular problem	27.1	30.2	25.0	25.4	24.7	16.5
Mental health						
Anxiety reaction/panic disorder	41.1	31.7	15.5	30.0	21.5	11.5
Depression	53.3	50.1	31.8	39.8	35.8	20.3
PTSD	34.2	27.4	12.7	34.8	22.0	15.2
Gastrointestinal						
Acid reflux/GERD	26.7	40.4	42.1	25.2	33.8	33.3
Hearing/vision						
Cataracts	0.9	12.0	46.3	1.2	12.2	38.1
Tinnitus	19.6	20.7	21.2	32.2	33.3	35.7
Hearing loss	3.4	9.3	22.7	9.2	22.0	40.1
Cardiovascular						
High cholesterol	16.0	46.6	60.4	26.0	54.8	61.6
Hypertension	14.1	44.5	65.1	25.9	60.8	70.2

Note: GERD = gastroesophageal reflux disease; PTSD = posttraumatic stress disorder.