



Health Effects of Military Service on Women Veterans

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Prepared by:

Evidence-based Synthesis Program (ESP) Center
West Los Angeles VA Medical Center
Los Angeles, CA
Paul G. Shekelle, M.D., Ph.D., Director

Investigators:

Principal Investigator:
Paul G. Shekelle, M.D., Ph.D.

Co-Investigators:

Fatma Batuman, M.D.
Bevanne Bean-Mayberry, M.D., M.H.S.
Caroline Goldzweig, M.D., M.S.P.H.
Christine Huang, M.D.
Donna L. Washington, M.D., M.P.H.
Elizabeth M. Yano, PhD, M.S.P.H.
Laurie C. Zephyrin, M.D., M.P.H., M.B.A.

Research Associate:

Isomi M. Miake-Lye, B.A.



PREFACE

Health Services Research & Development Service's (HSR&D's) Evidence-based Synthesis Program (ESP) was established to provide timely and accurate syntheses of targeted healthcare topics of particular importance to VA managers and policymakers, as they work to improve the health and healthcare of Veterans. The ESP disseminates these reports throughout VA.

HSR&D provides funding for four ESP Centers and each Center has an active VA affiliation. The ESP Centers generate evidence syntheses on important clinical practice topics, and these reports help:

- develop clinical policies informed by evidence,
- guide the implementation of effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures, and
- set the direction for future research to address gaps in clinical knowledge.

In 2009, an ESP Coordinating Center was created to expand the capacity of HSR&D Central Office and the four ESP sites by developing and maintaining program processes. In addition, the Center established a Steering Committee comprised of HSR&D field-based investigators, VA Patient Care Services, Office of Quality and Performance, and Veterans Integrated Service Networks (VISN) Clinical Management Officers. The Steering Committee provides program oversight and guides strategic planning, coordinates dissemination activities, and develops collaborations with VA leadership to identify new ESP topics of importance to Veterans and the VA healthcare system.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, ESP Coordinating Center Program Manager, at nicole.floyd@va.gov.

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EVIDENCE REPORT

INTRODUCTION

BACKGROUND

Women Veterans are among the fastest growing groups of new VA health care users of the VA healthcare system, and currently reflect approximately eight percent of all U.S. Veterans. With Operation Enduring Freedom and Iraqi Freedom (OEF/OIF), women comprise a larger percentage of the military (11.3 percent) than of prior military operations. As of fiscal year 2010, 51.3 percent of female OEF/OIF Veterans had enrolled in VA health care, in sharp contrast to women from previous eras (an estimated 11 percent). Of this group, 88 percent have used VA health care more than once.¹

To better understand the needs of this rapidly growing group, women Veterans' health research has expanded as well.² Two previous systematic reviews examined the literature on women Veterans' health and health care up to 2008.^{3,4} In this review, we specifically explored women Veterans' post-deployment health, with two main areas of concentration: 1) post-deployment effects on reproductive health for women Veterans, and 2) post-trauma sequelae among women Veterans from the OEF/OIF cohort.

The published literature on deployment and post-deployment health was included in the two previous systematic literature reviews. Most of the extant literature focused on the population of Veterans from OEF/OIF. The previous review also examined the reproductive health literature among military women and women Veterans. However, the previous reviews assessed the literature up through 2008, while the current review further updates these topics by examining them in more detail and extending the literature search through 2010.

METHODS

TOPIC DEVELOPMENT

This project was nominated by Patricia Hayes, PhD, Chief Consultant for the Women Veterans Health Strategic Health Care Group, with input from a technical expert panel.

The final key questions are:

Key Question #1: What research has been published on the effects of deployment on post-deployment reproductive outcomes?

We operationalized “reproductive effects” to encompass the following: fertility issues, birth defects, menstrual effects (e.g., change in cycles, loss of cycles), urinary tract infections, sexually transmitted infections, and reproductive cancers (e.g., cervical, ovarian, etc).

Key Question #2: What research has been published on post-trauma sequelae in OEF/OIF women Veterans, including: mental health problems, suicide, cardiovascular disease, risky health behaviors (including: tobacco use, hazardous alcohol use, substance abuse, homicide, assaultive behavior, and eating disorders), and other post-trauma sequelae?

SEARCH STRATEGY

The broader topic of research on women Veterans’ health has been the subject of two previous systematic reviews from our group. Those reviews included articles meeting our eligibility criteria through the end of their respective search dates. Goldzweig et al. (2006)³ covered women Veterans’ health and health care issues through 2004. In that systematic review, we identified 182 studies, including two randomized controlled studies and 180 studies with observational designs. Bean-Mayberry et al. (2010)⁴ updated the Goldzweig et al. search from 2004 through 2008. In that review, we identified 195 articles, with five articles describing results of randomized controlled trials. We assessed the original articles identified in these reviews for eligibility for inclusion in the current systematic review (as described below). We also developed a search strategy specific to the key questions for this review, covering the period from 2008 to the present. The search terms and Medical Subject Headings (MeSH) for the various search strategies are found in Appendix 1. Searches were conducted through August 2010.

STUDY SELECTION

Two team members (IML and PGS) reviewed the list of titles and selected articles for further review. Eligible articles had as their subject U.S. women Veterans, with a clear indication that they had been deployed, and reported outcomes on reproductive effects (including fertility issues, birth defects, menstrual effects, urinary tract infections, sexually transmitted diseases, and reproductive cancers); or had as their subject U.S. women Veterans of OEF/OIF and reported outcomes on post-trauma sequelae. Post-trauma sequelae included mental health problems, suicide, cardiovascular disease, risky health behaviors (including tobacco use, hazardous alcohol use, substance abuse, homicide, assaultive behavior, and eating disorders), and other post-trauma sequelae.

Because reviews of the effects of Agent Orange⁵ and Gulf War Syndrome⁶ already exist, we did not review their effects in any more detail in this review. Similarly, in our prior reports, we devoted sections to the literature on military sexual trauma (MST) and post-traumatic stress disorder (PTSD), and did not repeat that information here.

Because of the emerging nature of this particular literature, we did not require any restrictions on study design. Therefore, this review includes a wide range of observational and descriptive studies.

DATA ABSTRACTION

We abstracted the following data from included studies: sample characteristics, sample size, design, objectives, main measures, and main findings.

DATA SYNTHESIS

We constructed evidence tables showing the study characteristics and results for all included studies, organized by key question. (See Appendix 2 and Appendix 3.) We analyzed studies to compare their characteristics, methods, and findings. We compiled a summary of findings for each key question or clinical topic, and drew conclusions based on qualitative synthesis of the findings.

PEER REVIEW

A draft version of this report was sent to five peer reviewers and the report was extensively revised based on their input.

RESULTS

LITERATURE FLOW

The combined library contained 2,452 citations, of which we reviewed 57 articles at the full-text level. From these, we identified eligible studies that addressed one of the key questions. For Key Question #1, we found 15 studies; and for Key Question #2, we found 29. We grouped the studies by key question, and within each key question by topic area.

KEY QUESTION #1. What research has been published on post-deployment reproductive effects in any deployment of women Veterans?

We identified 15 articles⁷⁻²¹ that assessed the post-deployment effects on reproductive health for women Veterans. Two were about Vietnam Veterans^{9, 10} and 13 were about Gulf War Veterans.^{7,8,11-21} There were two cases where there was more than one study assessing a particular post-deployment effect for a particular war: there were two studies that assessed gender-specific effects in Gulf War Veterans,^{7,19} and eight studies that assessed the frequency of birth defects following the Gulf War.^{9,11-14,16,18,20}

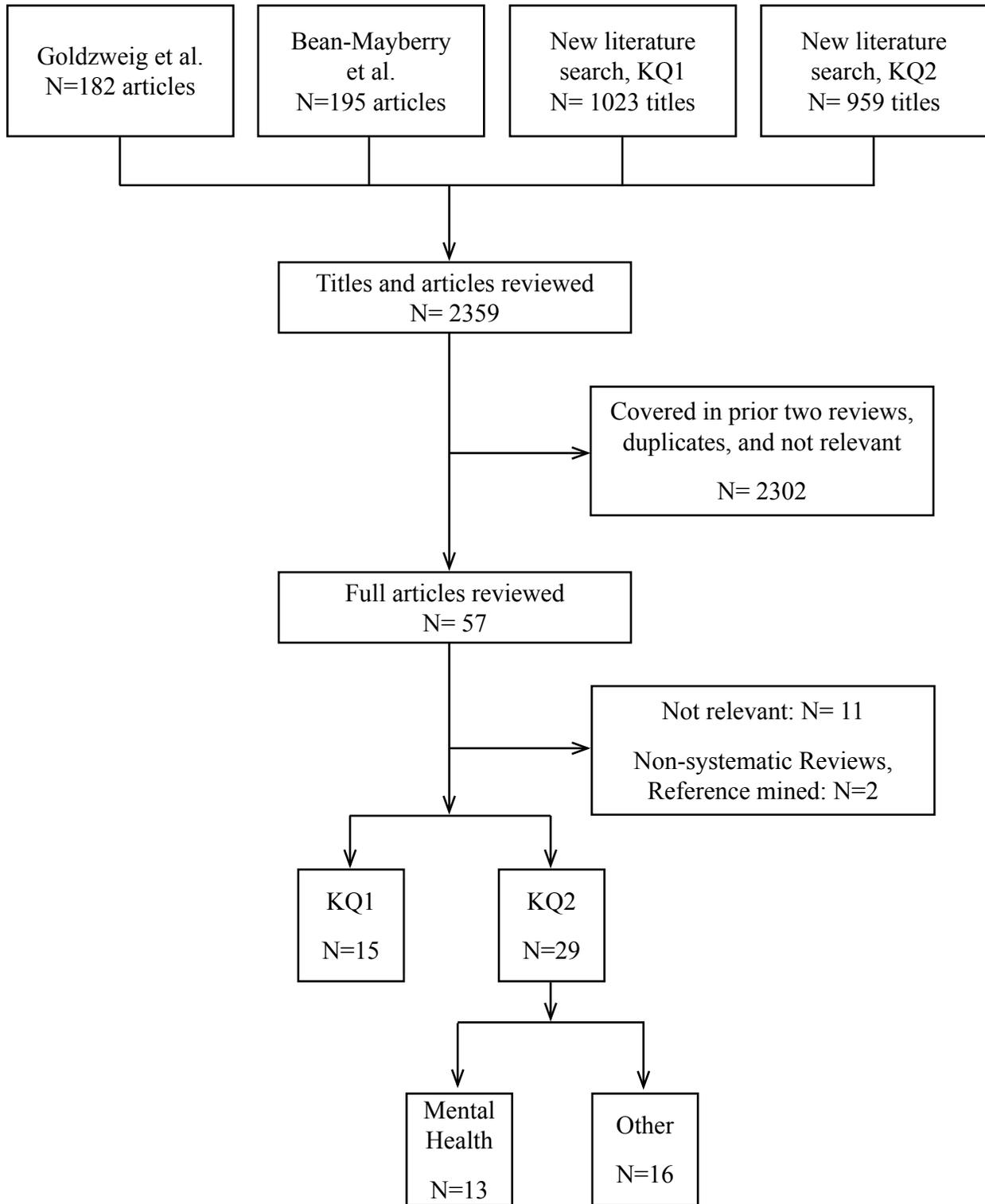
Gynecologic Cancer – Vietnam Women Veterans

Kang et al. studied the prevalence of gynecologic cancers among female Vietnam Veterans.¹⁰ In this study, 4,140 female Vietnam Veterans and 4,140 female Veteran controls from other military eras completed a structured telephone interview regarding any history of gynecologic cancer. As a measure of association between the risk of cancer and military service in Vietnam, odds ratios and 95 percent confidence intervals were calculated using multiple logistic regression models that yielded estimates of potential confounders. Data revealed that 8 percent of Vietnam Veterans and 7.1 percent of non-Vietnam Veterans reported a history of gynecologic cancers (breast, ovary, uterus, and cervix), but this difference was not statistically significant. Female Vietnam Veterans have not experienced a higher prevalence of gynecologic cancer in the 30 years since the conflict.

Sexual Function – Gulf War Women Veterans

In a case control study, Gilhooly et al. compared female sexual dysfunction in female Gulf War Veterans with or without chronic fatigue syndrome.¹⁵ The 26 female Veterans with symptoms consonant with chronic fatigue syndrome, as assessed in an enrollment questionnaire, were compared to 22 female Veterans without indications of chronic fatigue syndrome. Those with chronic fatigue had worse sexual dysfunction (defined as a positive response to a query about generalized difficulty with sexual function) than the 22 female Veterans without chronic fatigue syndrome (60 percent vs. 10 percent, $p=.002$). Of note, many of the subjects with chronic fatigue also had Axis I psychiatric disorders.

Figure 1. Literature Flow Chart



Conception/Fertility/Pregnancy

Vietnam Women Veterans

Kang et al.⁹ analyzed pregnancy outcomes among female Vietnam Veterans in a case control study. The cohort study compared self reported pregnancy outcomes for 4,140 female Vietnam Veterans with those of 4,140 non-deployed female Veterans. As a measure of association, they calculated odd ratios and 95 percent confidence intervals using logistic regression adjusting for age at conception, race, education, military nursing status, smoking, drinking, and other exposures during pregnancy. There was no statistically significant association between military service in Vietnam and adverse pregnancy outcomes (i.e., spontaneous abortion, low birth weight, or pre-term delivery). However, the risk of likely or moderate to severe birth defects (i.e., likely defects included congenital anomalies and included structural, functional, metabolic or hereditary defects) was significantly higher among Vietnam Veterans versus non-Vietnam Veterans (10.5 percent vs. 7.0 percent and 7.7 percent vs 5.8 percent respectively).

Gulf War Women Veterans

Araneta et al. studied conception and pregnancy during the Persian Gulf War and the risk to female Veterans. 1,558 completed (response rate 50 percent, of an original sample of 3,105) the questionnaire.⁷ Self-reported reproductive outcomes and dates, gestational data, and individual deployment dates identified 415 Gulf War exposed pregnancies, 298 Gulf War Veteran postwar conceptions, and 427 non-deployed women Veteran pregnancies. Pregnancy outcomes for Gulf War exposed conceptions and non-deployed conceptions were similar. However, spontaneous abortions and ectopic pregnancies were elevated for Gulf War Veterans who conceived postwar. Specifically, in the adjusted analyses, GWV postwar conceptions had a three-fold risk of spontaneous abortion (adjusted OR 2.92, 95% CI 1.9, 4.6) and nearly an eight times higher risk of ectopic pregnancy (adjusted OR 7.70, 95% CI 3.0, 19.8) compared to non-deployed Veterans.

A similar study was performed by Wells and colleagues.¹⁹ These authors sampled 20,000 subjects from the Defense Manpower Data Center, equally divided between men and women, who were either deployed or non-deployed Veterans during the 1991 Gulf War, who were married, and who were between the ages 18 and 33. The response rate to a survey about reproductive issues was 51 percent (8,742 out of 17,140 with valid addresses). Among 2,235 female and 2,159 male participants there were no differences in birth weight outcomes between Gulf War and non-deployed Veterans. As opposed to the results of Araneta and colleagues,⁷ this study found no differences between groups in the risk for ectopic pregnancies, stillbirths, or miscarriages. The reasons for the discrepancy in results between the two studies are unclear. Both studies had lower-than-desired response rates (about 50 percent for each), and perhaps the discrepant results merely reflect the experience of the Veterans who elected to respond to the surveys.

Birth Defects

Penman 1996¹⁸ used population based registries to examine birth defects and live-born and stillborn children born to men and women in two National Guard units in southeast Mississippi who were deployed from August 1990 through July 1991. From these two units, 54 children were compared to the birth defect rates observed in the general public, using the following birth defect surveillance systems: Metropolitan Atlanta Congenital Defects Program, the Centers for Disease Control's Birth Defects Monitoring Program, and the California Birth Defects Monitoring

Program. They concluded that the observed number of birth defects among children conceived by and born to this group of Persian Gulf War Veterans was not greater than expected on the basis of population-based registries.

Cowan 1997¹⁴ compared the overall risk of birth defects among 33,998 infants born to GWV and 41,463 infants born to non-deployed Veterans (NDV) at 135 military hospitals between 1991 and 1993. In this study, there was no increase in birth defects among children of GWV. The prevalence of any birth defect was 7.45 percent for deployed Veterans and 7.59 percent for non-deployed Veterans (RR 0.98, 95% CI 0.93-1.03). There was no significant association between service in the Gulf War and the prevalence of any birth defect for male Veterans (OR 0.97, 95% CI 0.91-1.03) or female Veterans (OR 1.07, 95% CI 0.94-1.22) even after adjustment for mother's age at delivery, race or ethnicity, and marital status of parent at the time of the Gulf War. This article is significant for its large sample size, use of medical record data to ascertain the outcomes of interest, and its multivariable analysis that included adjusting for multiple potential confounders.

Araneta 2000¹² studied offspring born to Gulf War Veterans (GWV) and non-deployed Veterans (NDV) by cross-referencing personal records of military personnel with birth certificates and the Hawaii Birth Defects Program records between 1989 and 1993. The pilot study identified 17,182 military infants of GWV and 13,465 infants of NDV in Hawaii and compared prevalence congenital anomalies through the first year of life. In this study, the prevalence of 48 birth defects was similar in NDV and GWV groups in conceptions that happened before the war and conceptions during and after the Gulf War. This study was limited by small numbers of case infants with birth defects and thus did not have adequate statistical power for rare defects. Additionally, they were unable to evaluate the role of maternal GWV exposure because of the small numbers of births in female GWV (165 births) in Hawaii.

Araneta 2003¹³ expanded the study to include infants born to Gulf War Veterans (GWV) and non-deployed Veterans registered in Arkansas, Arizona, California, Georgia, Hawaii and Iowa Birth Defects Program in 1989 to 1993. The sample size was 11,961 infants of GWV and 33,052 infants of NVD. Approximately 4,400 infants were born to women Veterans, and of these 450 infants were born to women Veterans who had been deployed in the Gulf War. Among 308 infants born to GWV women after the war, compared to 1,959 infants born to non-deployed women Veterans, the only difference that was statistically significant was the frequency of hypospadias and epispadias (4 cases among 308 in GWV and 4 cases among 1,959 non-deployed Veterans, Relative Risk = 6.4, 95% CI = 1.5, 26.8). However, for 47 other defects, no statistically significant differences were found. These data were unadjusted for potential confounders. Parenthetically, the study found in male GWV a higher incidence in various cardiac valve defects in offspring.

Werler 2004²⁰ identified cases from craniofacial centers in 26 cities (US and Canada). In specific, this study was concerned with a potential effect of military service on the risk of offspring with hemifacial microsomia, also known as Goldenhar syndrome. There were 232 cases of infants with Goldenhar syndrome and 832 controls ascertained from the pediatricians of cases or from a similar practice, and matched within two months of the birth date of the case. The birth year of cases and controls were between 1996 and 2002. There were no statistically significantly

increased odds of Goldenhar syndrome in multivariable analyses for military service by either mother or father, or by any parent having served in the Gulf War. There was a statistically significant association for any parent being in the Army (adjusted odds ratio = 2.4, 95% CI 1.4, 4.21); however, this study does not provide evidence supporting an association between Gulf War service and the presence of Goldenhar syndrome.

Langlois 2009¹¹ reported on a population based case control study assessing 30 major birth defects. The study is national and contains data on military service. In analyses adjusted for maternal age, race/ethnicity and education, there was no statistically significant association for any of the 30 major birth defects and military service since 1990, for infants born between 1997 and 2003. However, due to the small numbers of parents reporting military service, the 95 percent confidence interval in most estimates are wide (for example, among 202 cases of spina bifida, there were three mothers with military service for a rate of 1.5 percent, compared with a rate of 1.1 percent of control infants whose mothers had military service, yielding an adjusted odds ratio of 0.72, 95% CI 0.26, 2.01).

A study by Kane et al,⁹ previously discussed in the conception/fertility/pregnancy section, also assessed the association of Vietnam deployment in birth defects. The authors reported that the risk of likely or moderate to severe birth defects (i.e., likely defects included congenital anomalies and included structural, functional, metabolic, or hereditary defects) was significantly higher among Vietnam Veterans versus non-Vietnam Veterans (10.5 percent vs. 7.0 percent and 7.7 percent vs. 5.8 percent, respectively).

One additional study, reported in only a few paragraphs, surveyed 11,441 Gulf War Veterans and 9,476 non-Gulf War Veterans, and there were 6,043 pregnancies.¹⁶ The survey response rate was stated as 70 percent. Female Gulf War Veterans “reported more miscarriages and stillbirths” than non-Gulf War Veterans, but “neither [difference] was significant.” No other details were presented. The author also reported that “female Gulf War Veterans were nearly three-fold likelier than control subjects to have a child with likely birth defect (adjusted O.R. 2.97, 95% CI 1.47-5.99).” Again, no additional details are reported.

General Gynecologic/Reproductive Health

Pierce studied physical and emotional health of female Gulf War Veterans.⁸ Five hundred twenty-five women participated in the study following the war and again in a follow-up study two years later (sampled from members of the Air Force: active, guard, or reserve). Measures included general physical health, gender specific health, “Gulf War Syndrome,” and PTSD. Multiple statistical analyses were used to describe women’s physical and emotional health at these two time points. Deployed female Veterans reported significantly more general and gender specific health problems than did women who were not deployed during that conflict. The reproductive findings included abnormal pap smears (10.4 percent vs. 4.9 percent) and breast cysts/lumps (13.4 percent vs. 6.0 percent) in women deployed to the Gulf versus other regions. Additional research is warranted to define the health effects and their etiology.

Murphy et al. studied the healthcare implications for female Veterans and active duty troops.¹⁷ They performed a literature review using MEDLINE and collected data from VA and DOD registries. There were 49,950 female troops deployed to the Persian Gulf during Operations Desert Shield and Storm. The mean age of deployed women was the same as for men, 26.5. The

most common complaints involved minor orthopedic, acute respiratory, dermatologic, dental, and acute GI problems. A similar percentage of women and men presented with these outpatient complaints. However, women made proportionally more visits to sick call than men, and 26 percent of visits by women were for gynecologic problems (uterine bleeding, amenorrhea, fungal vaginitis, and request for oral contraceptive refills were common reasons for visits by female troops). Only three percent of all visits by women required referrals to gynecologists.

Wittich²¹ examined the creation of the Gulf War comprehensive clinical evaluation program at Tripler Army Medical Center. Of the first 100 Veterans seen, 16 percent were women. Half of the 16 Gulf War female Veterans experienced gynecologic problems while deployed and 43 percent have had problems since returning. There is no comparison done with non-deployed Veterans or the general population in this study. After returning from active duty, six patients became pregnant, five had normal outcomes and one had a miscarriage.

Summary of KQ1

The evidence base for reproductive effects of deployment of women Veterans is modest, mostly consisting of single studies of specific deployments and particular outcomes. Of note, there have been no published assessments of reproductive effects of the current (since 2003) deployments. Data about reproductive effects from past deployments are insufficient to reach strong conclusions. Because many of the outcomes of interest (birth defects, gynecologic cancers) are rare, large sample sizes are needed to assess for possible associations, and often times response rates for large sample studies are below desirable levels. This makes the interpretation of findings questionable.

KEY QUESTION #2. What research has been published on post-trauma sequelae in OEF/OIF women Veterans, including: mental health problems, suicide, cardiovascular disease, risky health behaviors (including: tobacco use, hazardous alcohol use, substance abuse, homicide, assaultive behavior, and eating disorders), and other post-trauma sequelae?

For Key Question #2, we note here that, as opposed to Key Question #1, all studies in this section concern OEF/OIF Veterans.

Mental Health

Thirteen publications focused on mental health sequelae and covered three general areas: depression and suicide,²²⁻²⁵ needs and utilization,²⁶⁻³⁰ and risk factors for mental health diagnosis.³¹⁻³⁴

Depression and Suicide

A study by Wells and colleagues²⁵ prospectively investigated new-onset depression by deployment status and gender. Deployed men and women with combat exposures had the highest rates of onset of depression. Compared to non-deployed men and women, combat-deployed men and women were at increased risk for depression (men: adjusted odds ratio [AOR]=1.32; 95% CI=1.13, 1.54; women: AOR=2.13; 95% CI=1.70, 2.65), whereas deployment without combat

exposures led to decreased risk (men: AOR=0.66; 95% CI=0.53, 0.83; women: AOR=0.65; 95% CI=0.47, 0.89). This study was part of the Millennium Cohort Study, and uses standardized survey questions for both outcomes and predictors.

Three studies examined suicide rates. Zivin and colleagues²² reported on clinical and demographic factors associated with suicide among depressed Veterans. This study used data collected as part of VA's National Registry for Depression, and provides longitudinal service use data and pharmacy data for over 1.5 million Veterans diagnosed with depression since 1997. The primary outcome was suicide as defined by the National Death Index. Among 807,964 Veterans included in this study (which excluded bipolar depression, schizophrenia, schizoaffective, cases prior to 1999, among other criteria), 1,683 (0.21 percent) committed suicide. Importantly, this study, while reporting that men are at greater risk for suicide than women, found that the male-to-female ratio in VA is somewhat less (3:1) than in the general population (4:1). McCarthy and colleagues²⁴ compared suicide rates among Veterans to that of the general population. Overall, for men and women combined, suicide risks among Veterans Health patients were 66 percent higher than those observed in the general US population. For male patients, the crude VHA suicide rate was 43.13/100,000 person-years, compared with 23.2/100,000 person-years among males in the general population, with age-adjusted standardized mortality ratio of 1.66 (95% CI=1.58, 1.74). For female patients, the crude suicide rate was 10.41/100,000 person-years, compared with 5.22/100,000 person-years among females in the general population, with a standardized mortality ratio of 1.87 (95% CI=1.35, 2.47). Another study by Kaplan and colleagues²³ specifically examined firearm use among Veteran suicide decedents. Across the age groups, male and female Veterans had higher firearm suicide rates than non-Veterans. Among males and females, younger Veterans (18 to 34 years) had the highest firearm and total suicide rates. The male and female Veteran suicide decedents were, respectively, 1.3 and 1.6 times more likely to use firearms relative to non-Veterans after adjusting for age, marital status, race, and region of residence.

Mental Health Care Needs and Utilization

Five studies focused on mental health care needs and utilization. Owens and colleagues²⁶ found that the most frequently reported concerns for which participants in this study of 50 OEF/OIF Veterans who completed an Internet survey indicated they needed counseling were depression (48 percent), relationship issues (38 percent), anxiety (36 percent), and anger management (30 percent). Although 78 percent of respondents reported that they felt they needed treatment in the past year, 42 percent of these individuals indicated that they did not seek counseling or treatment. Long waiting periods for appointments (33 percent) and prior bad experiences (28 percent) were the top two reported barriers to seeking mental health services in the VA.

In a logistic regression analysis, Chatterjee and colleagues²⁷ compared gender differences amongst a sample of 782,789 Veterans with at least one outpatient visit in the VA in FY99 associated with a mental health or substance abuse diagnosis and discovered that, overall, younger women Veterans (<35 years old) were significantly less likely and older women (35 to 54 years old) more likely to use any mental health services in comparison with their male counterparts. This trend held true for the subgroup of Veterans with a substance abuse (SA) or mood/anxiety disorder. However, among the subgroup of Veterans with PTSD or a bipolar/psychotic disorder, there were no significant gender differences in the likelihood of utilizing

mental health services. Among men and women Veterans 55 or older, there were no significant differences in utilization within diagnostic categories.

In a study by Seal and colleagues,³⁵ of 49,425 Veterans with newly diagnosed PTSD, only 9.5 percent attended nine or more VA mental health sessions in 15 weeks or less in the first year of diagnosis. Engagement in nine or more VA treatment sessions for PTSD within 15 weeks varied by predisposing variables (age and gender), enabling variables (clinic of first mental health diagnosis and distance from VA facility), and need (type and complexity of mental health diagnoses). Only a minority of Iraq and Afghanistan Veterans with new PTSD diagnoses received the recommended number and intensity of VA mental health treatment sessions within the first year of diagnosis.

A retrospective study by Wojcik and colleagues³⁰ of 473,964 U.S. Army soldiers deployed to Iraq and Afghanistan through December 2004 examined mental disorder hospitalizations, with a total of 1,948 psychiatric hospitalizations of deployed soldiers. The most common mental problems were mood, adjustment, anxiety, and substance-abuse related disorders. Both female soldiers and enlisted soldiers had significantly greater risks for mental disorder hospitalizations in both OIF and OEF operations as compared to their male and non-enlisted counterparts, with relative risks of ranging from 1.6 to 3, and 2 to 6, respectively. Younger women had the highest incidence of attempted suicide/self-inflicted injuries.

The fifth study by Cohen and colleagues²⁸ compared utilization of VA non-mental health medical services across three groups of Iraq and Afghanistan Veterans: those without mental disorders, those with mental disorders other than PTSD, and those with PTSD. Veterans with mental health diagnoses, particularly PTSD, had significantly greater utilization of non-mental health medical services. Female sex and lower rank were also independently associated with greater utilization.

Risk Factors for Mental Health Diagnosis

Four studies focused on risk factors for mental health diagnoses or the development of mental health disorders. Rundell and colleagues³¹ characterized 1,264 OEF and OIF military personnel who were psychiatrically evacuated from the theater of operations. When compared with all returned OEF/OIF Veterans, psychiatric evacuees were more likely to be: female, under the age of 31 years, African-American or Hispanic, enlisted or National Guard/Reserve. Over 80 percent of patients were evacuated during the first six months, compared with 17 percent during the second six months of deployment.

In a study of 289,328 Iraq and Afghanistan Veterans by Seal and colleagues,³² 36.9 percent of the Iraq and Afghanistan Veterans received mental health diagnoses, including 21.8 percent with new PTSD diagnoses followed by 17.4 percent with depression diagnoses. Adjusted two-year prevalence rates of PTSD increased four to seven times after the invasion of Iraq. Active duty Veterans younger than 25 years had higher rates of PTSD and alcohol and drug use disorder diagnoses compared with active duty Veterans older than 40 years (adjusted relative risk = 2.0 and 4.9, respectively). Women were at higher risk for depression than were men, but men had over twice the risk for drug use disorders. Greater combat exposure was associated with higher risk for PTSD. Baker and colleagues³³ found that only a minority (36 percent) of their study OEF/OIF Veterans and reservists who enrolled at the VA San Diego Healthcare System did not screen positive for mental health symptoms; the remainder met threshold PTSD, depression, or

substance and alcohol abuse. Gender, age, race, and rank were not significantly related to PTSD; whereas most recent branch of service and report of injury during combat were.

An additional literature review by Street and colleagues³⁴ highlights the emerging issues relevant to the development of PTSD among women deployed to Iraq and Afghanistan. The review explores gender differences in combat experiences and in PTSD following combat exposure; sexual assault, sexual harassment, and other interpersonal stressors experienced during deployment; women Veterans' premilitary trauma exposure; and unique stressors faced by women Veterans during the homecoming readjustment period. The authors conclude that gender-specific risk of PTSD differs substantially by type of traumatic event.

Summary of Mental Health Post-Trauma Sequelae

The above 13 publications focusing on the post-deployment mental health of our OEF/OIF Veterans found increased risks for new-onset depression, suicide, and firearm suicide; discrepancy between the mental health needs and utilization of mental health services, greater risks for mental disorder hospitalizations, and higher utilization of non-mental health medical services among Veterans with mental health diagnoses; and higher risks for mental diagnoses among certain subgroups.

Other Post-trauma Sequelae

Sixteen publications focused on post-trauma sequelae in areas other than mental health. These include: spinal cord injury and disorder and traumatic brain injury,³⁶⁻³⁸ alcohol and substance abuse,³⁹⁻⁴¹ health assessments and tools related to post-trauma sequelae,⁴²⁻⁴⁴ general health concerns,⁴⁵⁻⁴⁸ and miscellaneous post-trauma sequelae.⁴⁹⁻⁵¹

Spinal Cord Injury and Disorder (SCI&D) and Traumatic Brain Injury (TBI)

The first study of 8,983 unique SCI&D users of VA health care during 2001 focused on geographical distance as a VA barrier to care?³⁶ LaVela et al. found that patients in general used outpatient services less frequently when VA facilities were farther from their residence; however, male Veterans were less likely than female Veterans to use outpatient care (i.e., fewer annual visits). However, in this population of all SCI&D Veterans, women comprised only two percent of the sample and further studies are warranted to confirm and understand trends in utilization patterns for this subgroup. Loney³⁷ examined war wounded (n = 47) and non-war wounded (n = 72) men and women aged 18 years and older with TBI in a retrospective cohort study and noted that those with war injuries versus non-war injuries experienced lower functional scores and took longer periods to transition to rehabilitation centers. This study included 10 women. Additionally, Bell³⁸ looked at closed and penetrating TBI and found that most head injuries admitted to military hospitals were in males (98 percent), and most types consisted of penetrating brain injuries due to blast explosions.

Alcohol and Substance Abuse

In the substance abuse literature, alcohol misuse was greater among OEF/OIF young men compared to non-OEF/OIF men and either group of women. No difference in rates of alcohol misuse was present for the two groups of OEF/OIF and non-OEF/OIF women.⁴⁰ However, in an OEF/OIF sample of women Veterans who had positive PTSD symptoms, 47 percent screened positive for high risk drinking.⁴¹ Separately, re-admission rates for inpatient drug treatment

differed among women and men Veterans.³⁹ Sexual and physical abuse in childhood, the military, or prior two years were the most potent predictors of readmission for women while substance abuse, aggression, and cognitive impairment were potent predictors for men.

Health Assessments and Tools

For studies evaluating health assessments and tools, females were less likely to report health changes on Post Deployment Health Assessments,⁴³ and the Post Deployment Readjustment Inventory combined with other tools found that type of war exposures differed by gender.⁴² Women reported a higher rate of MST than men, and men reported a higher rate of witnessing others injured or killed than women.⁴² Fitzgerald⁴⁴ provided a primary care nurse practitioner guide for screening women Veterans in civilian primary care settings for post-traumatic stress disorder (PTSD), traumatic brain injury (TBI), and military sexual trauma (MST) with supportive data for each screening tool described and with the recommendation for accurate diagnosis and treatment of women Veterans who might be seen for routine care.

General Health Concerns

For post-deployment general health concerns, four articles involving women OEF/OIF Veterans were identified.⁴⁵⁻⁴⁸ One study indicated that first time deployments were associated with increased post-deployment distress in men and women, while the association between increased deployment length and post-deployment distress was found for men only.⁴⁵ However, women deployed with combat exposures were 1.78 times more likely to develop disordered eating and 2.35 times more likely to lose an extreme amount of weight when compared with women who deployed but did not report combat exposures.⁴⁸ For returning OEF/OIF Veterans, women were more likely to use outpatient services, but once initiated the frequency of visits over time did not differ by gender.⁴⁶ For returning OEF/OIF Veterans using VA care, women were less likely to report any pain, compared to male Veterans. For those with pain, women were more likely to report moderate to severe pain, but were less likely to report persistent pain compared to men Veterans.⁴⁷

Miscellaneous Post-Trauma Sequelae

Lastly, we identified three eligible studies that did not fit any of our existing categories; they are described here. The first⁴⁹ identifies more health care use, less satisfaction and poorer perceptions of VHA facilities and staff among women with a history of military sexual trauma. Of the 1,496 participants, 288 reported that they experienced military sexual assault, 137 reported at least one episode of combat exposure, and 37 indicated that they were exposed to both sexual assault and combat. Women with combat exposure also described more problems with VHA staff; no other differences were observed for those with and without a combat history. Fontana and colleagues⁵⁰ compared different eras of war Veterans by demographics and traumatic exposures. Recent Iraq and Afghanistan serving Veterans differed from Vietnam Veterans by being younger, more often female, more often working, and less often reporting exposure to atrocities in war. Finally, Zouris and colleagues⁵¹ completed a retrospective review of hospitalization data of soldiers evacuated from combat zones in Operation Iraqi Freedom noting most were non-battle injuries (75 percent), Army personnel (83.5 percent) and were male (90 percent). However, ICD-9 diagnoses differed by gender among those wounded or injured with women more often having neoplasms, mental disorders, diseases of the blood, respiratory and genitourinary symptoms compared to the men.

Summary of Other Post Trauma Sequelae

The post-trauma sequelae highlights three visible issues: 1) early TBI data show a preponderance of men from the military; ongoing evaluation is needed to understand what, if any, gender issues may be important for ongoing care; 2) alcohol use in recently returning women Veterans presents greater risk at lower levels of consumption for women with other risk conditions (PTSD, MST, combat trauma); and 3) health care utilization by gender and diagnosis requires ongoing follow up because while women may initiate contact with VA sooner, utilization did not differ. Moreover, conditions examined so far for deployed or post-deployed women manifest differently (pain syndromes) or differ in cause for evacuation from theatre. Individual studies also examined a number of other possible associations, such as eating disorders, pain, post-deployment distress, etc.; data are too sparse to draw firm conclusions.

SUMMARY AND DISCUSSION

LIMITATIONS

The primary limitation of this review, as with any review, is the possibility that we may have missed relevant articles. We only identified a modest amount of studies. It is possible that there are additional studies which we did not identify. However, our literature search procedures were extensive and included canvassing experts from academia regarding studies we may have missed. It was not possible to conduct formal tests for publication bias, but even with such tests it is not possible to exclude the possibility that such bias exists. Therefore, readers are cautioned about this possibility.

In addition, many of the studies used small sample sizes, or were from single centers or otherwise of questionable generalizability, had poor response rates, and relied on patient self-report for the outcomes of interest, or outcomes of uncertain validity. Therefore, the applicability of conclusions to the general population of deployed women Veterans is uncertain.

CONCLUSIONS

With the continued expansion of women's role in the military, better understanding of the potential health effects of military service on women during and after their military service is essential. While the emerging literature in this area is relatively limited to date, several important themes are nonetheless apparent.

The evidence on the influence of military service on reproductive health is mixed and relies on a modest literature base. Generally, pregnancy outcomes do not appear to differ among deployed vs. undeployed women. However, while several studies demonstrate non-significant differences by deployment status, others present contradictory evidence on the influence of military service on rates of spontaneous abortion, stillbirths, and ectopic pregnancies. Influences on birth outcomes raise more questions than they answer. Only one study reported birthweights, which did not appear to differ by deployment experience of their mothers. More studies have focused on birth defects: about half indicate there are no significant differences in birth defect rates among deployed vs. non-deployed women, whereas the other half report higher rates that are not statistically significant (reflecting problems in statistical power associated with sample sizes for these rare events) or, in fact, reflect higher rates.

The evidence on post-trauma sequelae among OEF/OIF women (soldiers and Veterans) is also relatively limited, and reflects a chief emphasis on mental health issues. Most of these studies are descriptive, and allude to gender differences in diagnosis, impact and health care utilization. Depression and suicide are major foci, demonstrating the highest rates of incident depression among women who are deployed and also exposed to combat. Interestingly, deployment without such exposure was associated with lower rates of incident depression than non-deployment. Women Veterans also had higher risks for depression than men, though lower substance use disorders. Suicide risk was reported as being lower among women Veterans, but the standardized mortality ratio among female Veterans is reportedly higher than that of male Veterans. Several of these studies focused on the differences among Veterans vs. non-Veterans more than women

vs. men. For example, the suicide rate among all Veterans (male and female) is estimated to be 66 percent higher than that of the general population. Also, among suicide decedents, women Veterans were 1.6 times more likely to use firearms (compared to non-Veterans).

The literature on mental health needs and utilization among OEF/OIF women Veterans was also descriptive and limited. Younger women Veterans were less likely than young male Veterans to use mental health services, which was in contrast to older Veterans (i.e., older women Veterans were more likely to use mental health services than older male Veterans). This pattern held overall and for those with substance abuse or mood/anxiety disorders, whereas no gender differences were found for PTSD care-seeking. Female soldiers had higher risks of hospitalization for mental disorders, and were more likely to be psychiatric evacuees from the field.

The remainder of the literature on other post-trauma sequelae was variable in topic. The evidence of problem drinking among OEF/OIF women Veterans is mixed (two studies which present contradictory findings). Some of this literature focuses on examining gender differences. For example, predictors of women Veterans' readmission rates for inpatient drug treatment include sexual and physical abuse before, during and after deployment (vs. substance abuse, aggression, and cognitive impairment among men). OEF/OIF women had higher rates of military sexual trauma (MST), and women with MST used VA care more, were less satisfied and had lower perceptions of VA facilities and staff, with particular problems with VA staff among those who had also had combat exposure. OEF/OIF women were less likely to witness the level of killing that men experienced and were less likely to have traumatic brain injuries (TBI) compared to men. Effects of deployment among OEF/OIF women included higher rates of moderate to severe pain, higher distress after the first deployment, and, when added with combat experiences, high rates of eating disorders and extreme weight loss.

FUTURE RESEARCH

In summary, differential effects of military service by gender are apparent, though the volume and quality of the literature are as yet modest. Given that the published scientific literature not uncommonly reflects prior years' research investment in different topic areas, we anticipate that the investment in women's health research by the U.S. Departments of Veterans Affairs and Defense will contribute to a rapidly growing literature base on the health effects of military service on women over the next several years. Such growth may warrant an updated systematic review, comparable to the overarching review that was recently updated,⁴ which demonstrated that more articles were published between 2004 and 2008 than the previous 25 years combined.

More research is needed on the reproductive health effects of military service. Currently, the evidence is mixed with respect to impacts on pregnancy and birth outcomes. One case control study reported an association between rates of birth defects and deployment status, begging the question about what elements of military service (or pursuit of service) might be contributing factors. The available literature also lacks descriptive evidence of the range of reproductive health issues that women in the military and women Veterans face. Currently, there are studies in progress that may well contribute substantively to this knowledge base, but that are not yet in the published literature.

The VA research portfolio on OEF/OIF Veterans' health and health care will also contribute to the emerging literature on the consequences of military service among OEF/OIF women Veterans. The current literature lays some of the groundwork but does so less comprehensively (spanning topics of mental health, physical health, social function, and so on) than would be optimal. Future research should begin to fill these gaps to produce an increasingly detailed portrait of their post-trauma sequelae.

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