



## 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](mailto:nicole.floyd@va.gov).

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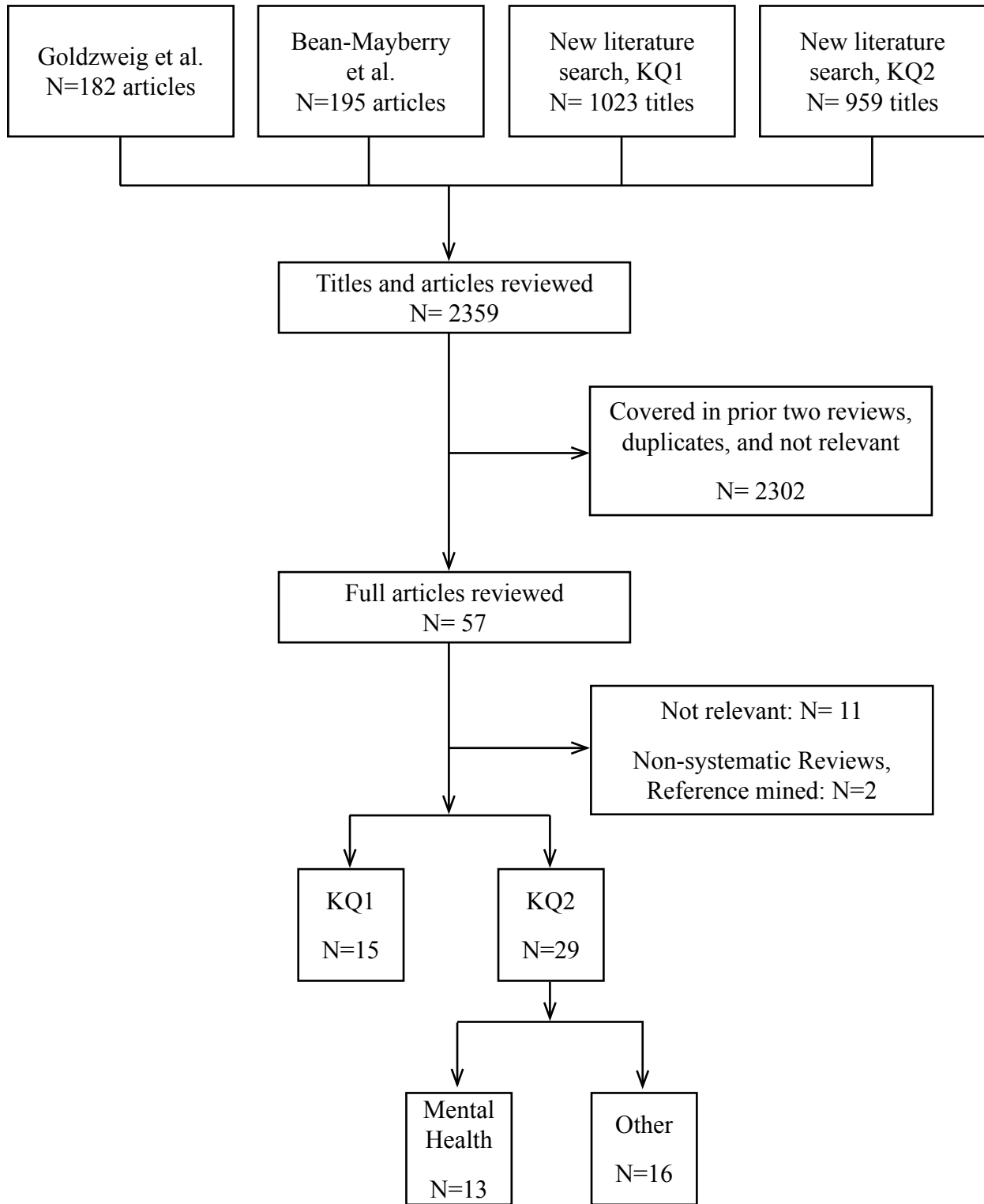








Figure 1. Literature Flow Chart





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 1997<sup>14</sup> 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 2000<sup>12</sup> 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 2003<sup>13</sup> 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 2004<sup>20</sup> 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













differed among women and men Veterans.<sup>39</sup> 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,<sup>43</sup> and the Post Deployment Readjustment Inventory combined with other tools found that type of war exposures differed by gender.<sup>42</sup> Women reported a higher rate of MST than men, and men reported a higher rate of witnessing others injured or killed than women.<sup>42</sup> Fitzgerald<sup>44</sup> 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.<sup>45-48</sup> 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.<sup>45</sup> 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.<sup>48</sup> 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.<sup>46</sup> 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.<sup>47</sup>

### *Miscellaneous Post-Trauma Sequelae*

Lastly, we identified three eligible studies that did not fit any of our existing categories; they are described here. The first<sup>49</sup> 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 colleagues<sup>50</sup> 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, Zourid and colleagues<sup>51</sup> 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,<sup>4</sup> 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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