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Gestational Diabetes and Hypertensive Disorders of Pregnancy Among Women Veterans Deployed in Service of Operations in Afghanistan and Iraq

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Abstract

Objective: To determine the prevalence of gestational diabetes (GDM) and hypertensive disorders of pregnancy (HDP) among women Veterans using Department of Veterans Affairs (VA) maternity benefits previously deployed in service of Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn (OEF/OIF/OND), and whether pregnancy complications were associated with VA use following delivery.
Methods: We identified the study population through linkage with the Department of Defense roster and VA administrative and clinical data. GDM and HDP were identified by International Classification of Diseases, Ninth Revision codes in VA inpatient or outpatient files. Similarly, we constructed a nationally representative sample of deliveries from the Nationwide Inpatient Sample. We calculated standardized incidence ratios (SIR) adjusted for age and year of delivery to compare rates of GDM and HDP. Proportional hazards regression was used to determine whether pregnancy complications were associated with use of VA following delivery.
Results: Between 2001 and 2010, 2,288 women OEF/OIF/OND Veterans used VA maternity benefits; 5.2% had GDM and 9.6% had HDP. Compared with women delivering in the United States, women OEF/OIF/OND Veterans using VA maternity benefits had higher risk of developing GDM (SIR: 1.40; 95% confidence interval [CI] 1.16, 1.68) and HDP (SIR: 1.32; 95% CI 1.15, 1.51). Among women OEF/OIF/OND Veterans using VA maternity benefits, GDM (HR 1.01, 95% CI 0.83, 1.24) and HDP (HR 1.07, 95% CI 0.92, 1.25) were not associated with use of VA following delivery.
Conclusions: Non-VA providers should be aware of their patients' Veteran status and the associated elevated risk for pregnancy complications. Within VA, focused efforts to optimize Veterans' preconception and postpartum health are needed.

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Introduction

Women Veterans are the fastest growing group of new Department of Veterans Affairs healthcare (VA) users, and an increasing number of women Veterans are of childbearing age.[1,2] Since 1996, VA has provided maternity benefits for women Veterans[3,4] by paying for care delivered by non-VA maternity care providers.[5] Over the last decade, the number of women Veterans seeking pregnancy related care from VA has increased steadily.[1,6] Nearly 40% of women Veterans who have used VA maternity benefits were deployed in service of operations in Afghanistan or Iraq (Operation Enduring Freedom, Operation Iraqi Freedom, and/or Operation New Dawn [OEF/OIF/OND]).[7]

Women OEF/OIF/OND Veterans have risk factors that may predispose them to pregnancy complications including obesity, belonging to high risk racial and ethnic groups, and a high prevalence of mental health conditions.[8–12] Gestational diabetes (GDM) and hypertensive disorders of pregnancy (HDP), including preeclampsia, are relatively common pregnancy complications associated with increased risk of adverse pregnancy and neonatal outcomes.[13–17] These conditions are also associated with increased maternal risk of type 2 diabetes and cardiovascular disease in later life,[18–20] though this risk may be reduced through adoption of healthy lifestyle practices.[21,22] Given that women Veterans receive VA maternity care from non-VA providers, coordination of care between VA and non-VA health systems is necessary to ensure seamless exchange of health information critical to preventative counseling and management of chronic diseases both during and after pregnancy. This is particularly true of women with GDM and HDP, but it is unclear if women with these pregnancy complications are more or less likely to return to VA following delivery. The primary objectives of this study were to (1) determine the prevalence of GDM and HDP among women OEF/OIF/OND Veterans who use VA maternity benefits, (2) compare it with the general population of women delivering in the United States, and (3) to describe pattern of contact with VA health services in the year following delivery and the frequency of post pregnancy contact with VA, and determine whether pregnancy complications are associated with the timing or frequency of use of VA services in the year following delivery.

Materials and Methods

Data source and study population

Women Veterans. Women Veterans were identified by linking the OEF/OIF/OND roster, a list of Veterans deployed in service of OEF/OIF/OND who separated from military service between October 1, 2001 and September 30, 2010, to the VA enrollment files.[23] The roster includes information on Veterans' sex, date of birth, race, deployment dates, and military service component (National Guard [Guard], Reserve, or Active duty) and is linked to administrative and clinical data contained within the VA National Patient Care Database and the Decision Support System.[23] These data include healthcare use, cost, pharmacy and laboratory data, and health encounters with coded diagnostic and procedure data associated with VA and fee basis inpatient and outpatient encounters. Fee basis care is paid for by VA, but delivered by non-VA community providers.[5]

We included all women OEF/OIF/OND Veterans who used VA maternity benefits for deliveries, which occurred between October 1, 2001, and September 30, 2010. Deliveries were identified by the presence of a diagnostic related group (DRG) code indicative of delivery in the VA inpatient or outpatient files or fee basis inpatient files. DRG codes are a series of codes used to indicate a specific package of medical services for the purposes of billing. The DRG codes used to indicate delivery by cesarean section were 370 and 371 between 2001 and 2007, and 765 and 766 from 2008 onward. The DRG codes used to indicate vaginal delivery were 374, 375, 372, and 373 between 2001 and 2007, and 767, 768, 774, and 775 from 2008 onward. *International Classification of Diseases*, *Ninth Revision* (ICD-9) codes were used to identify pregnancies complicated by GDM (648.8–648.82) or HDP, including gestational hypertension (642.3) and preeclampsia/eclampsia (642.4, 642.5, 642.6, 642.7).[24,25] Use of hospital discharge data for identifying cases of GDM has a sensitivity ranging from 69 to 96% and specificity between 99 and100% when compared with medical records.[26] Combining gestational hypertension and preeclampsia/eclampsia into a single category of HDP is recommended to decrease misclassification between specific categories (e.g., gestational hypertension vs. preeclampsia) and to increase sensitivity and specificity. Use of the combined codes has a sensitivity ranging from 49%–88% and specificity of 99% compared with medical records.[26] Veterans were considered to have a pregnancy complication if at least one ICD-9 code for a complication was present in either the VA or fee basis inpatient or outpatient files at delivery or in the nine months before the delivery date. Women with a prepregnancy ICD-9 code for diabetes and a code for GDM were classified as having prepregnancy diabetes rather than GDM ($n=4$).

Preexisting medical and mental health conditions, which were potentially associated with increased risk of complications and were markers for increased VA utilization prior to pregnancy, were identified by the presence of prespecified ICD-9s present for at least two outpatient visits or one inpatient visit between enrollment in VA health care and the date of delivery, with the exceptions of drug abuse/dependency and alcohol abuse/dependency for which only one outpatient visit was required as these codes were considered unlikely to have a high false positive rate.[27,28] ICD-9 codes for preexisting medical conditions included: hypertension (401–401.9, 402–402.91, 403, 404.x, 404.10, 404.90, 405.x, 437.2), hyperlipidemia (272–272.9), diabetes (250.00–250.93, 357.2), back problems or joint disorders (720.1–720.9, 713.0–716.9, 716.21–716.99, 718.1–718.29, 718.5719.99), and female genital disorders [fistula involving female genital tract (619), noninflammatory disorders of ovary fallopian tube and broad ligament (620), disorders of uterus not elsewhere classified (621), noninflammatory disorders of cervix (622), noninflammatory disorders of vagina (623), noninflammatory disorders of vulva and perineum (624), pain and other symptoms associated with female genital organs (625)].[1] ICD-9 codes for preexisting mental health conditions included depression (296.2–296.39), posttraumatic stress disorder (PTSD) (309.81), alcohol abuse/dependency (303.0–303.99, 305.0), and drug abuse/dependency (292.01–292.99, 304.0–304.99, 305.2–305.99).

Comparison population. We constructed a comparison population using the Nationwide Inpatient Sample (NIS)

from the Healthcare Cost and Utilization Project, a federal-state-industry partnership sponsored by the Agency for Healthcare Research and Quality. This data is collected annually from a stratified random sample of all community hospitals in participating states. The number of participating states increased from 33 in 2001 to 45 in 2010.[29] NIS includes all discharges from sampled hospitals, and has been demonstrated to be representative of all pregnancies in the United States and can therefore be used to produce nationwide estimates of complications of pregnancy.[30,31] Previously, NIS has been used to determine the prevalence of specific complications of pregnancy and the estimates produced are consistent with other national datasets.[31–34] Data collected includes ICD-9 codes, admission and discharge dates, and personal demographics. NIS does not collect data on veteran status; however, women Veterans make up approximately 2% of the overall U.S. population and therefore would be expected to comprise an extremely small portion of the deliveries captured in NIS.[35] Employing the same set of DRG and ICD-9 codes used to identify and characterize our VA sample of deliveries we first identified all delivery discharges and then stratifying by maternal age and year of delivery obtained stratum specific frequencies of GDM and hypertensive disorders of pregnancy using appropriate weights to obtain weighted frequencies.[29]

The protocol received institutional review board approval from VA Connecticut Healthcare System (CB 0002) and Yale University (0710003199) and an exemption from institutional review board review by VA Puget Sound Health Care System.

Study measures

Our primary outcomes were GDM, HDP (including gestational hypertension and preeclampsia/eclampsia), and use of VA services in the year following delivery by women Veterans. The delivery date was defined as the discharge date for the encounter containing the DRG for delivery. Use of VA services in the year following delivery was defined as receipt of any VA care, including specialty care, laboratory, X-ray, or pharmacy services, in the 365 days following delivery. We estimated the frequency of use of VA services in the year following delivery by calculating the total number of VA encounters in the 365 days after delivery, including the total number of visits to primary care and mental health as indicated by clinic stop codes (see Supplementary Table S1; Supplementary Data are available online at www.liebertpub.com/jwh).

Covariates were considered for the analysis that were *a priori* thought to be associated with pregnancy complications, to predict use of VA services following delivery, and to not be a consequence of pregnancy complications. These included demographic and military service characteristics, presence of medical or mental health conditions prior to delivery, VA use in the year prior to delivery and cesarean section. VA administrative data does not include detailed obstetric information; therefore, we used the date of delivery as the index date as we could not determine the length of gestation. Demographic characteristics included age at delivery (18–24, 25–34, or ≥ 35 years old), race/ethnicity (white, black, Hispanic, other, unknown), marital status (married, not married), and smoking (yes, no) as indicated by the most recent smoking assessment prior to delivery (mean time between smoking assessment and delivery = 330 days [stdev 300]), and prepregnancy body mass index (BMI) as indicated in the medical record before the delivery date (normal < 25 kg/m^2, overweight 25–29.9 kg/m^2, obese ≥ 30 kg/m^2; mean time between BMI measurement and delivery = 238 days, stdev: 116). Military service data included: rank (enlisted, officer), component (Guard, Reserves, Active duty), and greater than one deployment (yes, no). Preexisting medical and mental health conditions included those described earlier occurring at least 280 days prior to the delivery date.

Use of VA services prior to pregnancy included the years of VA use (date of delivery minus the date of first VA encounter); the total number of VA encounters in the year preceding delivery, including specialty, pharmacy, and laboratory encounters; and the number of VA visits to primary care and mental health in the year before delivery based on clinic stop codes (See Supplementary Table S1).

Statistical analysis

We used indirect standardization to calculate standardized incidence ratios (SIR), adjusting for maternal age and year of delivery, to compare the prevalence of GDM and HDP among women OEF/OIF/OND Veterans using VA maternity care with the general population of women delivering in the United States. The limited number of Veteran deliveries did not allow for further stratification by race/ethnicity. Observed rates in the NIS comparison population were used to calculate the expected number of cases in the study population, and the observed cases were then compared with the expected number of cases.[36] In the study population of women OEF/OIF/OND Veterans we combined years 2001–2003 as there were few ($n = 6$) deliveries during these years. We report the SIRs and 95% confidence intervals. As NIS contains only information for the delivery discharge and not for antenatal care, we conducted two sensitivity analyses to determine the extent to which the lack of antenatal care data may have biased our results. The first sensitivity analysis only included complications of pregnancy among OEF/OIF/OND women Veterans that were identified in the VA delivery discharge records. The second sensitivity analysis included complications of pregnancy that were either identified in the delivery discharge records or appeared at least twice in the antenatal record.

Kaplan-Meier curves were used to examine the time to first use of VA services following delivery among women OEF/OIF/OND Veterans using VA maternity benefits. The mean and median time to first VA encounter following delivery are reported for the total study sample and by presence of pregnancy complications. Cox proportional hazards regression was used to determine whether GDM or HDP were associated with use of VA services in the year following delivery. Time to event was time from delivery to first VA visit. Women who did not return to VA for health care in the year following delivery were censored at one year from delivery (365 days). The final model was adjusted for age, race/ethnicity, marital status, number of VA encounters in the year prior to delivery, and years of VA use. Preexisting medical and mental health conditions were not included in the final model as they were highly correlated with VA use in the year prior to delivery. Hazard ratios and their 95% confidence intervals are presented. Statistical significance was defined at the two-sided

Table 1. Characteristics of Women Operation Enduring Freedom, Operation Iraqi Freedom, and/or Operation New Dawn Veterans Who Used Department of Veterans Affairs Maternity Benefits Between 2001 and 2010, by Presence of Pregnancy Complications

Characteristics	*Total* (n = *2288*)	*Complications of pregnancy*[a]		
		None (n = *1966*)	*GDM* (n = *118*)	*HDP*[b] (n = *219*)
Demographic				
Mean age (years) (stdev)	23.6 (3.6)	23.5 (3.4)	24.7 (4.5)	24.2 (4.0)
Age group *n* (%) (years)				
18–24	1,612 (70.5)	1,403 (71.4)	73 (61.9)	143 (65.3)
25–34	641 (28.0)	538 (27.4)	41 (34.8)	69 (31.5)
≥35	35 (1.5)	25 (1.3)	4 (3.4)	7 (3.2)
Race/ethnicity *n* (%)				
White	1,256 (54.9)	1,092 (55.5)	55 (46.6)	118 (53.9)
Black	451 (19.7)	389 (19.8)	15 (12.7)	47 (21.5)
Hispanic	291 (12.7)	246 (12.5)	20 (17.0)	26 (11.9)
Other	178 (7.8)	147 (7.5)	15 (13.4)	17 (7.8)
Unknown	112 (4.9)	92 (4.7)	11 (9.3)	11 (5.0)
Married *n* (%)[c]	681 (29.8)	592 (30.1)	34 (29.1)	56 (25.8)
Current smoking *n* (%)[c]	383 (19.9)	308 (19.4)	22 (22.0)	48 (25.1)
Prepregnancy BMI (kg/m^2) *n* (%)[c]				
<24.9	931 (43.0)	828 (44.5)	39 (34.5)	69 (33.5)
25–29.9	725 (33.5)	631 (33.9)	39 (34.5)	56 (27.2)
≥30	508 (23.5)	400 (21.5)	35 (31.0)	81 (39.3)
Military service				
Enlisted *n* (%)	2,219 (97.0)	1,906 (97.0)	118 (100)	210 (95.9)
Component *n* (%)				
Guard	340 (14.9)	295 (15.0)	17 (14.4)	29 (13.2)
Active duty	1,634 (71.4)	1,404 (71.4)	87 (73.7)	157 (71.7)
Reserves	314 (13.7)	267 (13.6)	14 (11.9)	33 (15.1)
>1 deployment *n* (%)	655 (28.6)	553 (28.1)	34 (28.8)	77 (35.2)
Preexisting medical conditions				
Hypertension n (%)	50 (2.2)	31 (1.6)	5 (4.2)	16 (7.3)
Hyperlipidemia n (%)	54 (2.4)	46 (2.3)	5 (4.2)	3 (1.4)
Diabetes *n* (%)	12 (0.5)	10 (0.5)	0	2 (0.9)
Back problems/joint disorders *n* (%)	396 (17.3)	322 (16.4)	34 (28.8)	44 (20.1)
Female genital disorders *n* (%)	216 (9.4)	178 (9.1)	11 (9.3)	28 (12.8)
Pre-existing mental health conditions				
Depression *n* (%)	205 (9.0)	173 (8.8)	11 (9.3)	23 (10.5)
PTSD *n* (%)	389 (17.0)	319 (16.2)	25 (21.2)	47 (21.5)
Alcohol abuse/dependency *n* (%)	77 (3.4)	66 (3.4)	5 (4.2)	6 (2.7)
Drug abuse/dependency *n* (%)	37 (1.6)	33 (1.7)	2 (1.7)	3 (1.4)
VA use prior to delivery				
Length of VA use (years)				
Mean (stdev)	1.7 (1.4)	1.7 (1.4)	1.9 (1.4)	1.8 (1.4)
Median (IQR)	1.3 (0.6–2.5)	1.2 (0.6–2.5)	1.6 (0.7–2.9)	1.5 (0.7–2.7)
VA use in the year prior to delivery				
Total VA encounters				
Mean (stdev)	8.5 (9.4)	8.3 (9.3)	11.0 (11.4)	9.4 (8.7)
Median (IQR)	6 (3–10.5)	6 (3–10)	8 (4–13)	6 (4–13)
Primary care visits				
Mean (stdev)	2.4 (2.0)	2.4 (1.9)	3.0 (2.6)	2.5 (2.0)
Median (IQR)	2 (1–3)	2 (1–3)	2 (2–4)	2 (1–3)
Mental health visits				
Mean (stdev)	2.0 (5.5)	1.9 (5.4)	2.6 (7.3)	2.2 (5.1)
Median (IQR)	0 (0–1)	0 (0–1)	0 (0–2)	0 (0–2)
Delivery				
Cesarean section *n* (%)	663 (29.0)	529 (26.9)	43 (36.4)	97 (44.3)

[a]Complications were not mutually exclusive: 15 women had gestational diabetes and a hypertensive disorder of pregnancy.
[b]Includes gestational hypertension and preeclampsia/eclampsia.
[c]Missing data: married, *n* = 4; current smoking, *n* = 363; prepregnancy BMI, *n* = 126.
BMI, body mass index; GDM, gestational diabetes; HDP, hypertensive disorders of pregnancy; IQR, interquartile range; OEF/OIF/OND, Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn; PTSD, posttraumatic stress disorder; stdev, standard deviations; VA, Department of Veterans Affairs.

Table 2. Standard Incidence Ratios Comparing Pregnancy Complications of OEF/OIF/OND Women Veterans Using VA Maternity Care with Women Delivering in the United States 2001–2010

	Observed cases				
Complication	*Outpatient*	*Inpatient*	*Total*	*Total expected*	*SIR (95% CI)*[a,b]
GDM	40	78	118	84	1.40 (1.16, 1.68)
HDP	63	156	219	166	1.32 (1.15, 1.51)

[a]Adjusted for maternal age and year of delivery.
[b]Compares total observed cases with total expected.
95% CI, 95% confidence interval; SIR, standardized incidence ratios.

alpha level 0.05 and all analyses were conducted with STATA 12.[37]

Results

We identified 2334 women OEF/OIF/OND Veterans who used VA maternity benefits between October 1, 2001, and September 30, 2010. We excluded women whose first ($n=26$) or only VA contact ($n=16$) was at the time of their delivery as we had no information on their health prior to their pregnancy and limited data on their pregnancy. Deliveries are not routinely performed at VA medical centers except in rare emergency situations; therefore, we also excluded women whose only record of delivery was included in the VA files ($n=4$). Our final study population included 2288 Veterans (Table 1). Nearly half were racial or ethnic minorities, 29.8% were married, 19.9% were smokers, 23.5% were obese prior to pregnancy, and nearly all were previously enlisted servicewomen rather than officers. The most prevalent preexisting medical conditions were back problems or joint disorders (17.3%) and female genital disorders (9.4%). The most prevalent preexisting mental health conditions were PTSD (17.0%) and depression (9.0%). On average the Veterans in this study had used VA for 1.7 years (stdev 1.4) (median: 1.3; interquartile range [IQR] 0.6–2.5) with a mean of 8.5 VA encounters in the year preceding their delivery (stdev 9.4) (median: 6; IQR 3–10.5). Almost a third of deliveries were by cesarean section (29.0%).

In our study population the prevalence of GDM was 5.2% (n = 118) and the prevalence of HDP was 9.6% ($n=219$) [gestational hypertension 3.9% ($n=87$); preeclampsia/eclampsia 5.9% ($n=132$)]. There were 15 women who had both GDM and a HDP. Compared with Veterans without pregnancy complications, those with complications were older, more likely to be smokers, to be obese, to have multiple deployments, to have a preexisting medical or mental health condition, and to deliver by cesarean section (Table 1). Additionally, compared with women without pregnancy complications, those with complications used VA more frequently in the year preceding delivery. OEF/OIF/OND women Veterans in our study population were younger on average than women in the NIS comparison population. Among OEF/OIF/OND women Veterans in our study population 70% were 18–25 years old compared with 31% in the NIS sample. Supplementary Table S2 provides further details on the characteristics of the NIS sample and the overall prevalence of pregnancy complications by age group.

Table 2 shows the results of the comparison of OEF/OIF/OND Veterans using VA with the general population of women delivering in the United States. The number of cases of pregnancy complications identified through outpatient and inpatient files among OEF/OIF/OND Veterans is also indicated. Adjusting for age and year of delivery, compared with the general population of women delivering in the United States, OEF/OIF/OND Veterans using VA maternity benefits had a 40% increased risk of GDM (SIR 1.40, 95% confidence interval [CI] 1.16, 1.68) and 32% increased risk of HDP (SIR 1.32, 95% CI 1.15, 1.51). These differences were attenuated when we only included pregnancy complications present in the inpatient delivery record or that occurred at least twice in the outpatient records in the 9 months prior to delivery, and were no longer apparent when pregnancy complications among Veterans were

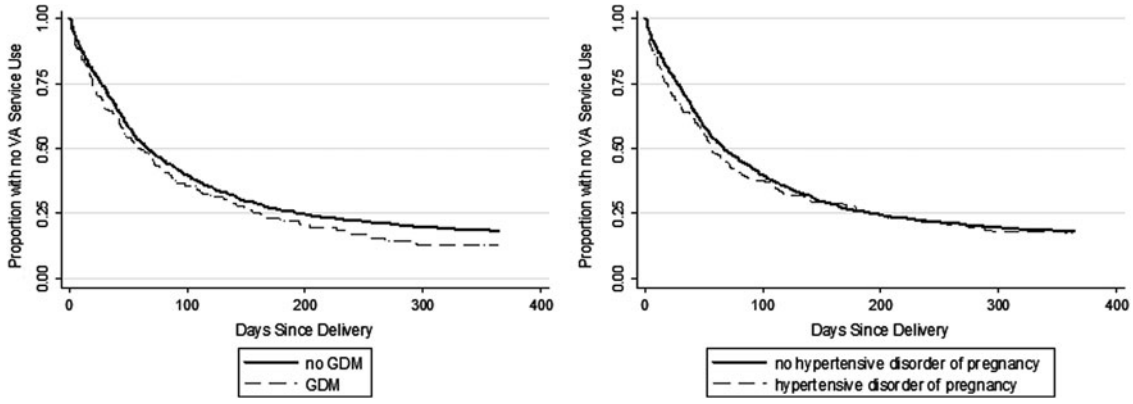

FIG. 1. Kaplan-Meier curves for use of VA services following delivery by presence of GDM and hypertensive disorders of pregnancy. GDM, gestational diabetes.

Table 3. VA Use in the Year Following Delivery Among Women OEF/OIF/OND Veterans Who Used VA Maternity Benefits Between 2001 and 2010, *N*=2228

		Complications of pregnancy		
	Total (n=*2288*)	*None* (n=*1966*)	*GDM* (n=*118*)	*HDP* (n=*219*)
Returned to VA within a year of delivery, *n* (%)	1878 (82.1)	1,607 (81.7)	103 (87.3)	181 (82.7)
***Among those returning to VA after delivery* (n=*1,811*)**				
Time to first VA encounter (days)				
Mean (stdev)	74.3 (74.3)	74.9 (74.2)	73.6 (74.4)	69.2 (76.0)
Median (IQR)	48 (20–103)	49 (22–103)	46 (17–109)	46 (13–89)
Total VA encounters in the year after delivery, (stdev)				
Mean (stdev)	8.9 (10.6)	8.7 (10.4)	11.3 (12.8)	9.8 (11.1)
Median (IQR)	6 (3–11)	6 (3–11)	7 (2–15)	6 (3–12)
Primary care visits				
Mean (stdev)	2.6 (2.6)	2.5 (2.6)	3.0 (3.2)	2.6 (2.4)
Median (IQR)	2 (1–3)	2 (1–3)	2 (1–4)	2 (1–4)
Mental health visits				
Mean (stdev)	2.3 (5.7)	2.2 (5.5)	2.7 (5.3)	2.8 (7.5)
Median (IQR)	0 (0–2)	0 (0–2)	0 (0–4)	0 (0–2)

IQR, interquartile range.

further restricted to those identified in the inpatient delivery records (data not shown).

Figure 1 shows the Kaplan-Meier curves for use of VA services in the year following delivery. Among Veterans who used VA maternity benefits, 82.1% used VA services in the year following delivery (Table 3). The mean time to first use of VA services following delivery was 74.3 days (stev: 74.3) (median: 48; IQR: 20–103). Of those who used VA services in the year following delivery, 88% had at least one primary care or mental health visit: the mean number of primary care visits in the year following delivery was 2.6 (stdev 2.6) (median: 2; IQR 1–3) and the mean number of mental health visits in the year following delivery was 2.3 (stdev 5.7) (median: 0; IQR 0–2). Among those who used VA services in the year following delivery, compared with those without pregnancy complications, a slightly higher percentage of those with GDM or a HDP used VA services in the year following delivery (no complications 81.7%; GDM 87.3%; HDP 82.7%). Women with and without pregnancy complications had similar median times to first VA encounter following delivery [no complications median: 49 days (IQR 22–103); GDM median: 46 (IQR 17–109); HDP median: 46 (IQR 13–89)].

Table 4. Association of Pregnancy Complications with Use of VA Services in the Year Following Delivery

Pregnancy complications[b]	$HR_{unadjusted}$ *(95% CI)*	$HR_{adjusted}$ *(95% CI)*[a]
GDM	1.16 (0.95, 1.42)	1.01 (0.83,1.24)
HDP	1.07 (0.92, 1.25)	1.07 (0.92,1.25)

[a]Adjusted for age, race/ethnicity, marital status, number of VA encounters in the year prior to deliver (number of visits), and length of VA use.

[b]Complications were not mutually exclusive: 15 women had gestational diabetes and a hypertensive disorder of pregnancy.

HR, hazard ratio.

After adjusting for age, race/ethnicity, marital status, number of VA encounters in the year prior to delivery, and years of VA use, compared with Veterans without pregnancy complications, those with GDM (hazard ratio [HR] 1.01, 95% CI 0.83, 1.24) or HDP (HR 1.07, 95% CI 0.92, 1.25) were no more or less likely to use VA services in the year following delivery (Table 4). Further adjustment for preexisting medical and mental health conditions did not appreciably change our results (data not shown).

Discussion

In this study we found that, compared with the general population of women delivering in the United States, women OEF/OIF/OND Veterans who used VA maternity benefits had a higher prevalence of GDM and HDP. The majority of Veterans in our study population used VA services in the year following delivery, and pregnancy complications were not associated with likelihood of use of VA services following delivery.

The excess risk of GDM and HDP among women OEF/OIF/OND Veterans using VA maternity benefits is potentially explained by the high burden of preexisting mental health and medical conditions in this population, which may be associated with increased risk of GDM and HDP.[24,25,38–46] Moreover, the high prevalence of back and joint disorders in this population may decrease physical activity and predispose to obesity, which could in turn increase the risk of pregnancy complications such as GDM and preeclampsia.[14,47] It is also possible that the excess risk of pregnancy complications we observed may reflect other unmeasured differences in risk factors between women OEF/OIF/OND Veterans using VA maternity benefits and the general population of women delivering in the United States, such as parity, past history of pregnancy complications, or gestational weight gain. Future research needs to carefully examine the frequency of known risk factors for pregnancy complications in this population.

Due to limited numbers in our study population, we were unable to further adjust for race/ethnicity. African American

women, who were overrepresented in our study population, are known to have elevated risk for HDP, but lower risk for GDM. Therefore, failure to adjust for race/ethnicity may have overestimated the risk of HDP associated with veteran status but underestimated the risk of GDM associated with veteran status. In addition, lack of data on smoking and prepregnancy BMI in the NIS dataset precluded our ability to adjust for these factors and compare populations. However, estimates of prepregnancy smoking in our study population were similar to those reported by large U.S. national surveys.[48]

This study demonstrated high rates (over 80%) of use of VA services following delivery for women Veterans with and without pregnancy complications. Among women with pregnancy complications lifestyle interventions and continued regular screening can reduce risk of development of type 2 diabetes and cardiovascular disease,[21,22] and may lower risk of complications in future pregnancies. Since approximately 80% of Veterans using VA maternity benefits return to VA, there is an on-going need for maternity care coordination so that VA providers are aware of a Veteran's history of pregnancy complications and can provide appropriate follow-up and interpregnancy care. Recent policy changes aim to improve coordination of maternity care between VA and non-VA fee basis providers and develop mechanisms for information exchange, through use of innovative technology.[49] There is also a need for increased emphasis on preconception care, which may reduce risk of primary or recurrence of GDM and HDP.

Our study had several strengths including the use of national data, linkage with multiple administrative databases, and verification of OEF/OIF/OND deployment through linkage with the OEF/OIF/OND roster. Limitations of this study include lack of outpatient data for the comparison population, lack of detailed obstetric information and lactation data, which is not available in VA administrative records, and generalizability to Veterans not using VA maternity benefits. Lack of outpatient data in NIS may have led to under ascertainment of pregnancy complications in the U.S. population compared with Veterans using VA maternity benefits. Prior work indicates that hospital discharge records have high specificity for identifying pregnancy complications but only moderate sensitivity[26] and that incorporation of outpatient antenatal care records may increase sensitivity by 5%–10%.[50,51] We found that reliance on inpatient delivery records alone reduced the prevalence of pregnancy complications among women OEF/OIF/OND Veterans by approximately 30%, suggesting that there was substantial under-ascertainment of pregnancy complications in the delivery records. Additional work is needed to validate the accuracy of VA administrative records for use in research on pregnancy and pregnancy outcomes. Since we did not have information on the length of pregnancy, we chose to use the delivery date as the index date for determining prepregnancy health status and use of VA services. Therefore, some of the descriptive variables such as BMI may reflect changes that occurred over the course of pregnancy. Importantly, when we excluded BMI measurements <280 days before the delivery date (those that most likely occurred during pregnancy), the prevalence of obesity remained unchanged (data not shown). Finally, we were only able to include women Veterans who used VA maternity benefits. Not all women Veterans use VA, and of those who use VA and become pregnant only a portion will use VA maternity benefits, thus our results may not be generalizable to all women Veterans. Furthermore, while OEF/OIF/OND Veterans currently make up 40% of those using VA maternity benefits results from this group may not be generalizable to Veterans using VA maternity benefits not deployed in service of these conflicts.

Conclusions

This is the first study to report the prevalence of pregnancy complications among women OEF/OIF/OND Veterans who use VA maternity benefits. Our findings suggest that women Veterans who use VA maternity benefits are a vulnerable population. Non-VA providers should be aware of their patients' Veteran status and their potential elevated risk for pregnancy complications. Within VA, focused efforts to optimize Veterans' preconception, postpartum, and interconception health are needed. Additionally, women Veterans are returning in high rates to the VA health care system for continued care following delivery. Research is needed to determine best practices for care coordination between health care systems and to understand the underlying causes of the observed high prevalence of pregnancy complications in this population and the variations in diagnoses between Veterans and non-Veterans, including Veterans who do not use VA maternity benefits.

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Author Disclosure Statement

No competing financial interests exist.

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