Is Military Deployment A Risk Factor for Maternal Depression?

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Abstract

Background: Maternal depression is a common condition among new mothers that can be associated with poor maternal health and negative consequences on infant health. Little research has been conducted to examine maternal depression, especially among military mothers, where unique conditions often exist. Using data from a large military cohort, this study prospectively examined the relationship between deployment experience before and after childbirth and maternal depression among U.S. servicewomen.

Methods: The study included 1,660 female Millennium Cohort participants who gave birth during active duty service and completed baseline and follow-up questionnaires between 2001 and 2008. Maternal depression was assessed at follow-up using Primary Care Evaluation of Mental Disorders Patient Health Questionnaire criteria.

Results: Deployment before childbirth, regardless of combat experience, and deployment without combat experience after childbirth did not increase the risk of maternal depression. Women who deployed and reported combat experience after childbirth were at increased risk for maternal depression compared with nondeployed women who gave birth (adjusted odds ratio [OR] 2.01, 95% confidence interval [CI] 1.17-3.43). Among the subgroup of female combat deployers, however, women who gave birth did not have a significantly increased risk for depression compared with those who did not give birth.

Conclusions: Military women who deployed with combatlike experiences after childbirth were at increased risk for postdeployment maternal depression. The risk, however, appeared primarily related to combat rather than childbirth-related experiences.

Introduction

DEPRESSION IS A GROWING EPIDEMIC that affects an estimated 17 million people each year in the United States.[1] Postpartum depression is a specific type of depression, with symptoms starting within the first 4 weeks after delivery, that affects approximately 10%–22% of new mothers.[2–4] Research has focused on postpartum depression in the general population, but little research has been conducted on maternal depression among military mothers, where unique occupational conditions often exist.[5,6] Understanding depression after childbirth in this important subpopulation of U.S. women is crucial for operational needs of the U.S. military and may be beneficial in occupationally similar settings, such as law enforcement. Although studies have shown employment

to be protective for postpartum depression among civilian women,[3] it is not known if the same association exists in military populations, where occupational requirements may include lengthy military deployments.[7] One previous study suggested higher rates of postpartum depression and suicidal ideation among active duty military women compared with civilian women.[5] Research has also demonstrated that depression and job stress are significantly correlated with one another.[6]

Approximately 16,000 women on active duty in the U.S. military give birth annually.[5] These women are a unique population because they are generally required to return to duty 6 weeks after birth, and they are usually considered deployable after 4 months.[8] New mothers serving on active duty have reported increased occupational and parenting

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stress, possibly a result of the nature of their work and rapid transition back to work.[8] Furthermore, it has been reported that female service members who deploy and report combat-associated experiences have an increased risk of depression.[9] Therefore, it is important to examine the potential increased risk for depression after childbirth among women who have experienced deployment either before or after giving birth.

The Millennium Cohort Study, a large population-based longitudinal study, was established to examine the long-term health of U.S. service members. It provides a unique opportunity to prospectively examine maternal depression in relation to deployment, combat-associated exposures, and other potential risk factors while controlling for behavioral characteristics and other occupational factors.

Materials and Methods

The Millennium Cohort Study was launched in 2001, before the start of military operations in Iraq and Afghanistan, to evaluate long-term health outcomes in the U.S. military population, as previously described.[10] Briefly, invited participants included a stratified random sample of US military personnel enrolled in three phases, referred to as panels, between 2001 and 2008. Currently, there are over 150,000 participants in the Cohort, representing 31% of those invited, who are surveyed every 3 years. Of the 77,047 consenting participants enrolled in the study's first panel between 2001 and 2003, 55,020 (72%) completed the first follow-up questionnaire between 2004 and 2006, and 54,790 (71%) completed the second follow-up questionnaire between 2007 and 2008. Of the 31,110 panel 2 participants enrolled between 2004 and 2006, 17,152 (55%) completed a follow-up questionnaire between 2007 and 2008.

Among the Millennium Cohort participants, there were 23,686 active duty women from the first two panels who completed a baseline and at least one follow-up questionnaire and had no missing covariate data. The main analyses excluded women who did not experience a childbirth between baseline and follow-up ($n = 11{,}547$), who were not active duty members throughout the survey periods ($n = 10{,}369$), who had a missing depression score ($n = 71$), or who gave birth to nonsingleton infants ($n = 39$), leaving 1,660 participants for inclusion.

Demographic and military-specific data, including maternal birth date, highest education level, marital status, race/ethnicity, deployment experience in support of the operations in Iraq and Afghanistan, pay grade, service component (active duty and Reserve/National Guard), service branch (Army, Air Force, Navy, Coast Guard, and Marine Corps), and occupation, were obtained from electronic personnel files.

Maternal depression

The Primary Care Evaluation of Mental Disorders Patient Health Questionnaire (PHQ), included as part of the Millennium Cohort questionnaire, provides a psychosocial assessment based on scores of several health concepts.[11] The nine depression items from the PHQ (PHQ-9) were used to measure maternal depression at follow-up. The PHQ-9 has been validated to assess depression using both simple and complex scoring algorithms.[11,12] Previous research has demonstrated that the simple algorithm is more sensitive (82%) and the complex algorithm is more specific (92%) when screening for

maternal or postpartum depression.[11] Although both methods were used in this study to assess maternal depression, our main results reflect the simple scoring method. Participants rate the severity of depressive symptoms from not at all to nearly every day during the 2 weeks preceding questionnaire completion. The simple scoring method sums the total score, with not at all = 0 points and nearly every day = 3 points. A score of 0–9 is classified as no depression, and a score of ≥ 10 is classified as having maternal depression.[11] For the complex algorithm, participants were defined as having maternal depression if they met the following two criteria: (1) endorsed having a depressed mood or anhedonia and (2) responded more than half the days or nearly every day to at least five of the nine items, with thoughts of being better off dead or hurting oneself being counted if present at all.

Deployment experience

The main exposure of interest was deployment in support of the operations in Iraq and Afghanistan. Deployment experiences before and after childbirth were examined separately and categorized into three levels: not deployed, deployed without combatlike exposures, and deployed with combatlike exposures. Deployed women were classified as having combatlike exposures if they reported personal exposure to one or more of the following in the 3 years before follow-up: person's death due to war, disaster, or tragic event; physical abuse; dead and decomposing bodies; maimed soldiers or civilians; or prisoners of war or refugees.

Dates of birth for children, as well as any birth defects detected before follow-up, were obtained from the Department of Defense (DoD) Birth and Infant Health Registry.[13] Women were identified as having multiple, separate childbirths if they experienced more than one singleton birth between baseline and follow-up assessment. The first childbirth experience was assessed for women who gave birth more than once within the 2001–2008 period.

Covariates

All covariates were measured at baseline. Smoking status was classified as nonsmokers, past smokers, or current smokers. Potential alcohol dependence was based on one or more positive responses to the CAGE questionanaire.[14,15]

The posttraumatic stress disorder (PTSD) Checklist-Civilian version (PCL-C) is a 17-item questionnaire embedded in the Millennium Cohort questionnaires. Individuals who reported a moderate or high level of at least one intrusion symptom, three avoidance symptoms, and two hyperarousal symptoms during the past 30 days with a total score of ≥ 50 points on a scale of 17–85 were classified as screening positive for PTSD.[16–18] Participants who self-reported having a doctor or other health professional ever diagnose them with PTSD were classified as having a previous PTSD diagnosis.

Similarly, participants who reported ever having a diagnosis of depression or who screened positive (PHQ-9) for major depression at baseline were classified as having a previous depression diagnosis or positive depression screen. The complex scoring method was used to assess baseline depression because it is more commonly used to assess major depressive disorder (MDD) and has high sensitivity and specificity.[19] Participants who reported ever having a diagnosis of a mental disorder other than PTSD and depression,

such as manic depressive disorder, schizophrenia, or psychosis, or reported currently taking medication for anxiety, depression, or stress were classified as having a previous mental health diagnosis or currently taking psychotropic medication or both.

Statistical analysis

Descriptive and univariate analyses were performed to compare characteristics by deployment and maternal depression. Multivariable logistic regression was used to evaluate the relationship between deployment experiences and maternal depression, adjusting for covariates. Two separate models examined deployment experiences before childbirth and after childbirth. Manual backward stepwise selection with a 0.10 p value criterion was implemented in the final models, although significance of the exposure and covariates was assessed at the alpha 0.05 level. In addition, variables that changed the association between deployment and maternal depression by >10%, as well as important demographic variables that past literature has shown to be associated with depression, were manually selected to remain in the reduced model. For all models, regression diagnostics were performed, including tests for goodness-of-fit and collinearity. All data management and statistical analyses were performed using SAS software, version 9.2 (SAS Institute, Cary, NC).

Secondary analyses

Additional analyses were performed to further examine postdeployment depression. The selection criteria for the secondary analyses remained the same as in the main analyses except participants had to have deployed and women who did not experience childbirth between baseline and follow-up were included in these analyses. The exposure of interest was deployment experience in support of the operations in Iraq and Afghanistan before follow-up by childbirth experience between baseline and follow-up assessments. Women were classified as deployed with no combat, no childbirth; deployed with no combat, with childbirth; deployed with combat, no childbirth; and deployed with combat, with childbirth. Covariates remained the same as the main analyses, with the exception of cumulative deployment days and time elapsed from deployment to birth. Logistic regression was also employed without manual stepwise regression.

Results

Of the 1,660 women in the study population, 1,193 (72%) did not deploy, 202 (12%) deployed without combat, and 265 (16%) deployed with combat before childbirth. After childbirth, 1,434 (86%) women did not deploy, 92 (6%) deployed without combat, and 134 (8%) deployed with combat exposures. At follow-up, 11% of the women screened positive for maternal depression.

Baseline characteristics by deployment experiences are reported in Table 1. Notably, women who experienced deployment, with or without combat, before childbirth were proportionately more likely to be younger, less educated, not married, and enlisted, as well as not having reported a previous childbirth within the past 3 years compared with women who did not deploy before childbirth. Furthermore, women who experienced deployment, with or without combat, after childbirth were proportionately more likely to be born between 1970 and 1979, married, and past smokers, as well as to have a previous childbirth and no prior depression diagnosis or symptoms compared with women who did not deploy after childbirth.

Women who deployed before childbirth and reported combat-associated exposures had the highest prevalence of maternal depression (16.6%, 95% confidence interval [CI] 14.8%-18.4%), followed by those who did not deploy before childbirth (10.1%, 95% CI 8.7%-11.5%), and women who deployed without combat before childbirth had the lowest prevalence (8.4%, 95% CI 7.1%-9.7%). Similarly, women who deployed with combat after childbirth incurred the highest prevalence of maternal depression (15.7%, 95% CI 13.9%-17.5%), followed by those who did not deploy after birth (10.7%, 95% CI 9.2%-12.2%) and those deployed without combat exposures (6.5%, 95% CI 5.3%-7.7%).

Univariate analyses of maternal depression at follow-up are shown in Table 2. Women who were born in 1970 or earlier, have a higher education, are nonsmokers, have no issues with alcohol, have no prior PTSD diagnoses or current symptoms, have no diagnoses of depression or current symptoms, have no other mental health diagnoses or currently are taking any medications, are military officers, serve in the Air Force or Marine Corps, or have <180 days of cumulative length of deployment before birth are significantly less likely to experience maternal depression.

After reduction, the final multivariable logistic regression models included age, education, marital status, ethnicity, CAGE, prior PTSD diagnosis or current symptoms, prior depression diagnosis or current symptoms, prior other mental health diagnosis or currently taking medication, and service branch. There was a significant association between deployment with combat exposures after childbirth and maternal depression but no significant association between deployment experience before childbirth and maternal depression (Table 3). Women who deployed and reported combat exposures after childbirth had twofold higher odds of screening positive for maternal depression compared with women who did not deploy after childbirth. In addition, in both deployment models, women who were born in 1980 or later, screened positive for PTSD or had a prior PTSD diagnosis at baseline, screened positive for depression or had a prior depression diagnosis at baseline, or reported taking medication for a mental health condition or had a prior other mental health diagnosis at baseline had significantly higher odds of maternal depression. Furthermore, Army soldiers had significantly increased odds of maternal depression compared with those serving in the Air Force and the Navy/Coast Guard (Table 3).

Among the 3,356 deployed participants in the secondary analysis, 676 (20.1%) women experienced childbirth (Table 4). Female deployers who experienced childbirth and combat were not at significantly increased odds of depression compared with female deployers who experienced combat without childbirth (adjusted odds ratio [AOR] 1.34, 95% CI 0.93-1.92). Women who deployed but did not report combat and did not give birth had significantly lower odds of depression (AOR 0.66, 95% CI 0.49-0.90) compared with women who reported combat and did not give birth. With the exception of birth year (not significant) and education (significant), covariates that were statistically significant in the main

TABLE 1. DEMOGRAPHIC CHARACTERISTICS OF MILLENNIUM COHORT STUDY FEMALE PARTICIPANTS
WHO GAVE BIRTH BETWEEN 2001 AND 2008 (n=1,660), BY DEPLOYMENT EXPERIENCE

	Deployment before childbirth n=1,660			Deployment after childbirth n=1,660		
Baseline characteristics	Not deployed n (%[a])	Deployed without combat exposure n (%[a])	Deployed with combat exposure n (%[a])	Not deployed n (%[a])	Deployed without combat exposure n (%[a])	Deployed with combat exposure n (%[a])
Total	1,193 (71.9)	202 (12.2)	265 (16.0)	1,434 (86.4)	92 (5.5)	134 (8.1)
Birth year[b,c]						
Pre-1970	214 (17.9)	10 (5.0)	29 (10.9)	204 (14.2)	17 (18.5)	32 (23.9)
1970–1979	602 (50.5)	87 (43.1)	107 (40.4)	675 (47.1)	52 (56.5)	69 (51.5)
1980–present	377 (31.6)	105 (52.0)	129 (48.7)	555 (38.7)	23 (25.0)	33 (24.6)
Education[b]						
Some college or less	1,004 (84.2)	191 (94.5)	245 (92.5)	1,247 (87.0)	81 (88.0)	112 (83.6)
Bachelor's degree or higher	189 (15.8)	11 (5.5)	20 (7.6)	187 (13.0)	11 (12.0)	22 (16.4)
Marital status[b]						
Not married	530 (44.4)	119 (58.9)	142 (53.6)	694 (48.4)	42 (45.7)	55 (41.0)
Married	663 (55.6)	83 (41.1)	123 (46.4)	740 (51.6)	50 (54.4)	79 (59.0)
Race/ethnicity						
Non-Hispanic white	698 (58.5)	105 (52.0)	142 (53.6)	822 (57.3)	50 (54.4)	73 (54.5)
Non-Hispanic black	247 (20.7)	51 (25.3)	60 (22.6)	302 (21.1)	27 (29.4)	29 (21.6)
Other	248 (20.8)	46 (22.7)	63 (23.7)	310 (21.6)	15 (16.3)	32 (23.9)
Smoking status[b]						
Never smoker	731 (61.3)	136 (67.3)	154 (58.1)	889 (62.0)	57 (62.0)	75 (56.0)
Past smoker	304 (25.5)	34 (16.8)	58 (21.9)	329 (23.0)	26 (28.3)	41 (30.6)
Current smoker	158 (13.2)	32 (15.8)	53 (20.0)	216 (15.1)	9 (9.8)	18 (13.4)
CAGE/alcohol screen						
No	1,060 (88.9)	190 (94.1)	232 (87.5)	1,282 (89.4)	83 (90.2)	117 (87.3)
Yes	133 (11.2)	12 (5.9)	33 (12.5)	152 (10.6)	9 (9.8)	17 (12.7)
Prior PTSD[b] diagnosis/current symptoms						
No	1,114 (93.4)	197 (97.5)	229 (86.4)	1,324 (92.3)	87 (94.6)	129 (96.3)
Yes	79 (6.6)	5 (2.5)	36 (13.6)	110 (7.7)	5 (5.4)	5 (3.7)
Prior depression diagnosis/current symptoms[c]						
No	998 (83.7)	182 (90.1)	223 (84.2)	1,199 (83.6)	86 (96.5)	118 (88.1)
Yes	195 (16.4)	20 (9.9)	42 (15.9)	235 (16.4)	6 (6.5)	16 (11.9)
Prior other mental health diagnosis/current medications						
No	1,092 (91.5)	192 (95.1)	239 (90.2)	1,311 (91.4)	89 (96.7)	123 (91.8)
Yes	101 (8.5)	10 (4.9)	26 (9.8)	123 (8.6)	3 (3.3)	11 (8.2)
Military rank[b]						
Enlisted	1,051 (88.1)	196 (97.0)	252 (95.1)	1,299 (90.6)	84 (91.3)	116 (86.6)
Officer	142 (11.9)	6 (3.0)	13 (4.9)	135 (9.4)	8 (8.7)	18 (13.4)
Service branch[b]						
Army	394 (33.0)	55 (27.2)	132 (49.8)	492 (34.3)	31 (33.7)	58 (43.3)
Air Force	481 (40.3)	90 (44.6)	79 (29.8)	569 (39.7)	35 (38.0)	46 (34.3)
Navy/Coast Guard	294 (24.6)	51 (25.3)	49 (18.5)	342 (23.9)	23 (25.0)	29 (21.6)
Marine Corps	24 (2.0)	6 (3.0)	5 (1.9)	31 (2.2)	3 (3.3)	1 (0.8)
Occupation[b]						
Combat specialists	99 (8.3)	17 (8.4)	26 (9.8)	123 (8.6)	8 (8.7)	11 (8.2)
Health care specialists	267 (22.4)	6 (3.0)	44 (16.6)	289 (20.2)	4 (4.4)	24 (17.9)
Service supply and functional	430 (36.0)	107 (53.0)	99 (37.4)	543 (37.9)	35 (38.0)	58 (43.3)
Other	397 (33.3)	72 (35.6)	96 (36.2)	479 (33.4)	45 (48.9)	41 (30.6)
Cumulative length of deployment (days)						
0	1,193 (100)	0	0	1,434 (100)	0	0
1–180	0	120 (59.4)	107 (40.4)	0	55 (59.8)	72 (53.7)
>180	0	82 (40.6)	158 (59.6)	0	37 (40.2)	62 (46.3)
Years elapsed between deployment and childbirth/childbirth and deployment						
No deployment	1,193 (100)	0	0	1,434 (100)	0	0
<1 year	0	171 (84.7)	222 (83.7)	0	34 (37.0)	53 (39.6)
>1 year	0	31 (15.4)	43 (16.2)	0	58 (63.0)	81 (60.5)

(continued)

	Deployment before childbirth n=1,660			Deployment after childbirth n=1,660		
Baseline characteristics	Not deployed n (%[a])	Deployed without combat exposure n (%[a])	Deployed with combat exposure n (%[a])	Not deployed n (%[a])	Deployed without combat exposure n (%[a])	Deployed with combat exposure n (%[a])
Child diagnosed with birth defect						
No	1,148 (96.2)	197 (97.5)	257 (97.0)	1,383 (96.4)	91 (98.9)	129 (96.3)
Yes	45 (3.8)	5 (2.5)	8 (3.0)	51 (3.6)	1 (1.1)	5 (3.7)
Previous childbirth[b,c]						
No	816 (68.4)	162 (80.2)	216 (81.5)	1,051 (73.3)	64 (69.6)	79 (59.0)
Yes	377 (31.6)	40 (19.8)	49 (18.5)	383 (26.7)	28 (30.4)	55 (41.0)
More than 1 childbirth between baseline and follow-up						
No	1,060 (88.9)	184 (91.1)	245 (92.5)	1,285 (89.6)	85 (92.4)	119 (88.8)
Yes	133 (11.2)	18 (8.9)	20 (7.6)	149 (10.4)	7 (7.6)	15 (11.2)

[a]Percentages are rounded and may not sum to 100.
[b]Covariate significantly associated with deployment before childbirth at the alpha level of 0.05 (association of cumulative length of deployment and years elapsed between deployment and childbirth/childbirth and deployment with deployment was not examined due to the zero cells from the inherent nature of the data).
[c]Covariate significantly associated with deployment after childbirth at the alpha level of 0.05 (association of cumulative length of deployment and years elapsed between deployment and childbirth/childbirth and deployment with deployment was not examined due to the zero cells from the inherent nature of the data).
PTSD, posttraumatic stress disorder.

analyses remained unchanged (results not shown). Results of analyses using the complex scoring method were similar to those using the simple scoring method. However, results from the complex scoring method lacked significance because of higher specificity, leading to less women screening positive for maternal depression (data not shown).

Discussion

Using prospective data from the Millennium Cohort Study, this study assessed military deployment and its temporal association with maternal depression. Results from the primary analyses suggest women who deploy and report combat-associated exposures after childbirth are significantly more likely to screen positive for maternal depression than are women who did not deploy after childbirth. However, the main analyses were unable to conclude if the increased odds of depression among combat deployers after childbirth was attributable to experiencing combat, experiencing childbirth and leaving a young child, or a combination of these factors. To better understand the relationship of deployment and childbirth with depression, secondary analyses were performed among active duty female deployers regardless of childbirth experience. Among women who deployed, those who had combatlike exposures and childbirth were at increased odds for depression, albeit not significant, compared with women who experienced combat and did not give birth. This suggests the increased rate of depression is primarily attributed to experiencing combat while deployed and is consistent with a previous report.[9]

Previous research has consistently found combat as one of the strongest predictors of postdeployment mental disorders among military personnel.[9,10] Therefore, it is not surprising to find that combat experience contributes most strongly to the increased risk of depression among deployed women who have previously given birth. It is also possible that giving birth and leaving a young child, in addition to the experience of combat, contribute to postdeployment depression, as this study did not have an adequate sample size to fully detect this relationship. In addition, 98 (58%) women who screened positive for depression at follow-up also screened positive for PTSD. It is conceivable that PTSD may modify the relationship between deployment and maternal depression and that the increased risk of maternal depression among combat deployers may be in part due to PTSD. Sample size also limited the ability to fully evaluate this potential interaction.

Regardless of combat experience, deployment before childbirth was not significantly associated with maternal depression in the current study. A probable reason may be the success of the military's reintegration and debriefing programs. For example, the Yellow Ribbon Reintegration Program focuses on supporting members of the U.S. Air Force and their families. It prepares families for the challenges of deployment and educates them on programs that are available to help ease their concerns about reintegrating into the community.[20] These types of resources may be successfully reducing the emotional and psychologic impact of deployment. Women may feel more prepared to start a family after returning from deployment. Furthermore, women who deployed before giving birth did not experience leaving their young child(ren) at home while deployed, which may also put them at less risk for maternal depression. An evaluation of stress debriefing interventions in a military population found an improvement of psychologic health because of these programs.[21]

In this study, women who screened positive for maternal depression were significantly more likely to be younger, report prior mental health disorders, or screen positive for PTSD or depression at baseline, and be in the Army. The increased risk of maternal depression in younger women is consistent with findings in previous studies in military and civilian populations.[22,23] This may be a result of the lack of experience and preparedness to embark upon motherhood at a young age. Additionally, women who screened positive for mental

TABLE 2. ODDS RATIO OF MATERNAL DEPRESSION
AMONG MILLENNIUM COHORT STUDY FEMALE
PARTICIPANTS BETWEEN 2001 AND 2008

Baseline characteristics	Simple scoring method[a] n=1,660		
	OR	95% CI	p
Deployment before childbirth			0.005
No	1.00		
Yes, without combat	0.82	(0.48-1.40)	
Yes, with combat	1.78	(1.22-2.59)	
Deployment after childbirth			0.087
No	1.00		
Yes, without combat	0.58	(0.25-1.35)	
Yes, with combat	1.55	(0.94-2.53)	
Birth year			<0.001
Pre-1970	1.00		
1970–1979	1.23	(0.72-2.07)	
1980–present	2.13	(1.27-3.57)	
Education			0.007
Some college or less	1.00		
Bachelor's degree or higher	0.43	(0.24-0.79)	
Marital status			0.365
Not married	1.00		
Married	0.87	(0.64-1.18)	
Race/ethnicity			0.240
Non-Hispanic white	1.00		
Non-Hispanic black	1.15	(0.79-1.67)	
Other	0.76	(0.50-1.16)	
Smoking status			0.005
Never smoker	1.00		
Past smoker	1.49	(1.04-2.15)	
Current smoker	1.87	(1.25-2.81)	
CAGE/alcohol screen			0.004
No	1.00		
Yes	1.87	(1.23-2.86)	
Prior PTSD diagnosis/current symptoms			<0.001
No	1.00		
Yes	6.76	(4.50-10.15)	
Prior depression diagnosis/ current symptoms			<0.001
No	1.00		
Yes	3.99	(2.84-5.59)	
Prior other mental health diagnosis/current medications			<0.001
No	1.00		
Yes	5.20	(3.50-7.72)	
Military rank			0.007
Enlisted	1.00		
Officer	0.35	(0.16-0.75)	
Service branch			<0.001
Army	1.00		
Air Force	0.35	(0.24-0.52)	
Navy/Coast Guard	0.66	(0.23-1.91)	
Marine Corps	0.58	(0.39-0.86)	
Occupation			0.993
Combat specialist	1.00		
Healthcare specialist	1.09	(0.57-2.05)	

(continued)

TABLE 2. (CONTINUED)

Baseline characteristics	Simple scoring method[a] n=1,660		
	OR	95% CI	p
Service supply and functional	1.03	(0.57-1.86)	
Other	1.03	(0.56-1.86)	
Cumulative length of deployment before childbirth (days)			0.004
0	1.00		
1–180	0.86	(0.53-1.42)	
>180	1.84	(1.25-2.71)	
Cumulative length of deployment after childbirth (days)			0.811
0	1.00		
1–180	1.20	(0.69-2.08)	
>180	1.04	(0.54-1.99)	
Years elapsed between deployment and childbirth			0.172
No deployment	1.00		
<1 year	1.36	(0.96-1.93)	
>1 year	1.41	(0.70-2.81)	
Years elapsed between childbirth and deployment			0.675
No deployment	1.00		
<1 year	1.33	(0.71-2.50)	
>1 year	1.01	(0.57-1.76)	
Child born with birth defect			0.572
No	1.00		
Yes	0.77	(0.30-1.94)	
Previous childbirth			0.888
No	1.00		
Yes	0.98	(0.69-1.38)	
>1 childbirth between baseline and follow-up			0.494
No	1.00		
Yes	0.83	(0.48-1.42)	

[a]Simple scoring method is assessed by summing the responses; a total score of ≥10 is considered a positive screening for maternal depression.
CI, confidence interval; OR, odds ratio.

health disorders or reported a prior mental health diagnosis at baseline had increased odds for maternal depression. Previous research has found that women are at increased risk for comorbid mental health disorders, including PTSD, anxiety disorders, and eating disorders, with depression.[24] Participants who served in the Army had an increased risk of maternal depression; Army service members tend to be deployed longer and more frequently than personnel serving in the Navy and Air Force.[25] Furthermore, there may be more ongoing imminent fear of deployment, which may contribute to increased risk of maternal depression.[26] Because of low numbers of female Marines, significant differences in depression rates may not have been detectable in this group.

The prevalence of maternal depression in the general population is approximately 12%, similar to the 11% found in the current study.[23] Previous military studies have found an

TABLE 3. ADJUSTED ODDS RATIO FOR MATERNAL DEPRESSION AMONG FEMALE MILLENNIUM COHORT
PARTICIPANTS WHO GAVE BIRTH BETWEEN 2001 AND 2008

	Deployment before childbirth			Deployment after childbirth		
Baseline characteristics	*AOR*	*95% CI*	p	*AOR*	*95% CI*	p
Deployment			0.505			0.025
No	1.00			1.00		
Yes, without combat	0.96	(0.55-1.70)		0.70	(0.27-1.76)	
Yes, with combat	1.27	(0.83-1.95)		2.01	(1.17-3.43)	
Birth year			0.010			0.005
Pre-1970	1.00			1.00		
1970–1979	1.07	(0.60-1.91)		1.11	(0.62-2.00)	
1980–present	1.88	(1.01-3.48)		2.02	(1.09-3.74)	
Education			0.179			0.180
Some college or less	1.00			1.00		
Bachelor's degree or higher	0.63	(0.32-1.24)		0.63	(0.32-1.24)	
Marital status			0.546			0.593
Not married	1.00			1.00		
Married	1.12	(0.78-1.61)		1.10	(0.77-1.59)	
Race/ethnicity			0.162			0.153
Non-Hispanic white	1.00			1.00		
Non-Hispanic black	1.21	(0.80-1.83)		1.24	(0.82-1.87)	
Other	0.73	(0.46-1.16)		0.74	(0.46-1.17)	
CAGE/alcohol screen			0.085			0.094
No	1.00			1.00		
Yes	1.52	(0.94-2.44)		1.50	(0.93-2.41)	
Prior PTSD diagnosis/current symptoms			<0.001			<0.001
No	1.00			1.00		
Yes	3.34	(2.07-5.40)		3.63	(2.26-5.83)	
Prior depression diagnosis/current symptoms			<0.001			<0.001
No	1.00			1.00		
Yes	2.25	(1.50-3.38)		2.24	(1.50-3.36)	
Prior other mental health diagnosis/ current medications			<0.001			<0.001
No	1.00			1.00		
Yes	3.55	(2.27-5.56)		3.56	(2.27-5.58)	
Service branch			<0.001			<0.001
Army	1.00			1.00		
Air Force	0.34	(0.22-0.52)		0.34	(0.22-0.51)	
Navy/Coast Guard	0.57	(0.37-0.87)		0.56	(0.37-0.86)	
Marine Corps	0.53	(0.16-1.70)		0.53	(0.16-1.73)	

Simple scoring method is assessed by summing the responses; a total score of ≥10 is considered a positive screening for maternal depression. Model adjusted for all variables in the table.

AOR, adjusted odds ratio.

elevated prevalence of postpartum depression when compared with civilian populations,[5–7] although there is no well-developed theory that explains this increased rate in military samples.[6,7] Many of these previous military studies were based on small study populations or included participants who were predisposed to postpartum depression, such as patients from hospitals known to treat complicated pregnancies. Women in this study who deployed before or after childbirth without combat exposures had no increased risk of maternal depression and had a lower prevalence than nondeployed women. Deployment-eligible individuals may be healthier, with lower risk of depression, than those not eligible to deploy, which may explain this result.

There are some limitations to this study. The PHQ was not specifically designed to assess postpartum or maternal depression. However, the PHQ is a widely used, validated instrument that has been shown to align with physician diagnosis of depression,[27] has been found to be internally valid within the Millennium Cohort,[28] and has high sensitivity and specificity as a screening tool.[11] Still, misclassification could occur. Self-reported depression symptoms may be more readily identified among those individuals reluctant to seek professional help because of stigma associated with mental health treatment.[29] Loss to follow-up may affect results, although analyses on weighting for nonresponse did not identify substantial bias at first follow-up examining PTSD, depression, and alcohol misuse effect measures.[30] Moreover, the prevalence of baseline depression was similar among participants who gave birth, regardless of whether they completed a follow-up questionnaire, suggesting little to no follow-up bias. The reliance on electronic databases for some maternal and childbirth data inevitably carries some degree of

Table 4. Adjusted Odds Ratio for Depression
Among Female Millennium Cohort Participants
Who Deployed Before 2008 (n = 3,356)

Exposure	Prevalence n(%[a])	AOR[b]	95% CI	p
Deployment[c]/ childbirth[d] status				0.002
No combat, no childbirth	74 (7.2)	0.66	(0.49-0.90)	
No combat, childbirth	19 (6.6)	0.66	(0.38-1.13)	
Combat, no childbirth	223 (13.5)	1.00		
Combat, childbirth	65 (16.7)	1.34	(0.93-1.92)	

[a]Percentages are rounded.
[b]Simple scoring method was used, assessed by summing the responses; a total score of ≥10 is considered as a positive screening for maternal depression. Model adjusted for age, education, marital status, ethnicity, CAGE, prior PTSD diagnosis or current symptoms, prior depression diagnosis or current symptoms, prior other mental health diagnosis or currently taking medication, and service branch.
[c]At least 1 deployment in support of the wars in Iraq and Afghanistan before follow-up.
[d]Record of at least 1 live childbirth between baseline and follow-up questionnaire.

miscoding; however, the capability to link to participants' medical records is a major strength.

This study was unable to include Reservists or those serving in the National Guard, and the prevalence of maternal depression may differ among these groups. Additionally, women who gave birth to nonsingleton infants were excluded because of differences in experience compared with singleton births. This study also did not include women who chose to leave or were discharged from the military around the time of childbirth. Women who received care from the military throughout the birthing process were captured whether or not they chose to leave the military after giving birth. Another limitation, because of sparse combat exposure data, was that all exposures to combat were evaluated as an aggregate measure; therefore, the investigation was unable to pick out specific combat exposures that may have led to the increased risk of depression. Finally, the positive screens for depression may have not been a result of childbirth; thus, the term maternal depression may not be completely applicable to all study participants. The secondary analysis compared risk for depression by childbirth status, which allowed for investigation of combat and childbirth factors.

A number of strengths should be noted. This is one of the first longitudinal studies to prospectively examine maternal depression in a military population. The temporal relationship between childbirth and deployment was examined, and many behavioral and service-related characteristics that often are difficult to obtain were included as potential risk factors for maternal depression. The ability to link data from the Millennium Cohort Study and the DoD Birth and Infant Health Registry provided an opportunity to study a potentially vulnerable population of women that is rarely accessible in a prospective manner. Previous investigations have found the Millennium Cohort to be well-representative of the U.S. military, with participants reporting reliable data and not influenced to participate by health status before enrollment.[10,28] In addition, inverse probability weighting has found no appreciable bias as a result of nonresponse.[30–37] Therefore, these results may be generalized to other female military populations.

Conclusions

Maternal depression is receiving increasing attention, and this study contributes important information on prevalence and risk factors among female U.S. service members. Results from this study and future studies can assist the military in focusing on personnel readiness among female U.S. service members after experiencing childbirth or after experiencing combat during deployment. Current findings may also further support the need for postdeployment social support and reintegration programs, regardless of childbirth, as deployment with combat-related experiences were clearly the most important predictors of depression in military women.

It may be important to note that in contrast to active duty women, military wives appear to have a clearly increased risk for postpartum depression related to a husband's deployment.[38] Future studies, including planned analyses of families within the Millennium Cohort, will better define the complex interactions of deployment and other military stressors on all family members. This is critically important because regardless of the origins of challenges, parental depression can have a profound and lasting impact on children and families.[39–41] Appropriate screening and early intervention can help adult service members affected by depression, the workplaces that depend on their service, and the children and family members who depend on their care.

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Human participation protection

This research has been conducted in compliance with all applicable federal regulations governing the protection of human subjects in research and was approved by the institutional review board, Naval Health Research Center, San Diego, CA (Protocol NHRC.2000.0007).

Disclosure Statement

The authors declare no financial interests exist.

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14. ABSTRACT
Background
Depression is a growing epidemic that affects an estimated 17 million people each year in the United States. Postpartum depression is a specific type of depression, with symptoms starting within the first 4 weeks of delivery and affecting approximately 10%–22% of new mothers. Research has focused on postpartum depression in the general population; however, little research has been conducted on maternal depression among military mothers where unique occupational conditions often exist. Understanding depression after childbirth in this important subpopulation of US women is crucial for operational needs of the US military.
Methods
The study included 1660 female Millennium Cohort participants who gave birth during active-duty service and completed baseline and follow-up questionnaires between 2001 and 2008. Maternal depression was assessed at follow-up using Primary Care Evaluation of Mental Disorders Patient Health Questionnaire criteria.
Results
Deployment prior to childbirth and deployment without combat experience after childbirth did not increase the risk of maternal depression. Women who deployed and reported combat experience after childbirth were at increased risk for maternal depression compared with nondeployed women who gave birth. However, among female combat deployers, women who gave birth did not have a significantly increased risk for depression compared with those who did not give birth.
Conclusions
Among deployment-experienced women, those who had combat-like exposures and childbirth were at increased odds for depression compared with women who experienced combat and did not give birth. This suggests the increased rate of depression is primarily attributed to experiencing combat while deployed.

15. SUBJECT TERMS
depression, postpartum, women, combat, veterans

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