

Health of Women after Wartime Deployments: Correlates of Risk for Selected Medical Conditions among Females after Initial and Repeat Deployments to Afghanistan and Iraq, Active Component, U.S. Armed Forces

Women account for approximately 10 percent of all U.S. military deployers to Afghanistan and Iraq. This analysis estimates the percentages of female deployers (n=154,548) who were affected by selected illnesses and injuries after first through third deployments to Iraq/Afghanistan in relation to age group, service branch, military occupation, marital status, pre-deployment medical history, “dwell time” prior to 2nd and 3rd deployments, and length of deployment. Of these factors, diagnosis of a condition before deployment was by far the strongest predictor of diagnosis of the condition after deployment. Durations of dwell times before repeat deployments were not strong predictors of post-deployment diagnoses of any of the conditions considered. For several conditions (e.g., PTSD, disorders of joints, peripheral enthesopathies, infertility), the percentages of deployers diagnosed with the conditions sharply increased with deployment length. Post-deployment morbidity moderately increased with increasing numbers of deployments in the case of some conditions (e.g., PTSD, migraine, musculoskeletal disorders), but not others. The findings suggest that limiting wartime deployments to nine months may have broad beneficial effects on the post-deployment health of female service members. However, limiting the number of wartime deployments and lengthening “dwell times” before repeat deployments would likely not have strong and broad beneficial effects on the health of female veterans. Further research to mitigate the effects of heavy loads and repetitive stresses on the musculoskeletal systems of combat deployed females is indicated.

For more than a decade, U.S. military forces have conducted continuous combat operations in Afghanistan (Operation Enduring Freedom [OEF]) and Iraq (Operation Iraqi Freedom [OIF], Operation New Dawn [OND]). The duration of continuous warfighting is unprecedented in U.S. military history. An inevitable consequence of the prolonged combat operations in Afghanistan and Iraq has been the repeated deployment of many service members to active war zones.

The nature of the warfighting in OEF/OIF/OND is also unprecedented for U.S. forces. For example, in the ongoing war, the enemy is not a sovereign nation; enemy combatants live among and dress like the indigenous civilians; and there are not clearly defined front lines, rear areas, conventionally organized enemy forces, or conventional weapons or tactics. As a result, many deployed U.S. military members – regardless of their military duties – have witnessed or

experienced firsthand the destruction and violence inherent to close combat. While the ongoing operations have unprecedented characteristics, they may be the usual for combat operations in the future.

Women account for approximately one-seventh (14%) of the active component of the U.S. military and approximately 10 percent of all U.S. military deployers to Afghanistan and Iraq. Participation in combat is inherently risky (e.g., battle injuries, post-traumatic stress disorder [PTSD], traumatic brain injury [TBI]). However, there are unique threats to the health of women in relation to military service in general and war-related service in particular. Many past and recent studies have focused on the health of women in military service in general and the health concerns of female veterans of wartime service during and after their deployments.¹⁻⁷

Previous *MSMR* reports highlighted the illnesses and injuries that were “most

excessive” among female OEF/OIF/OND deployers compared to various referent cohorts at various times following deployment (October 2009), after second through fifth compared to first deployments (July 2011), and of various mental disorders in relation to the number of previous deployments and the lengths of “dwell times” prior to repeat deployments (September 2011).⁸⁻

¹⁰ The conditions that were most excessive among females after repeat deployments included mental disorders (including PTSD), headache, neck and back disorders, and some female reproductive system and respiratory disorders.

This analysis extends the findings of previous *MSMR* reports by focusing on selected conditions in each category of disorders that are relatively excessive among female repeat deployers. Specifically, the analysis estimates the percentages of female deployers who are affected by selected conditions in each illness/injury category of interest after first through third OEF/OIF/OND deployments in relation to age group, service branch, military occupation (health care, other), marital status, pre-deployment medical history, “dwell time” prior to 2nd and 3rd deployments, and length of deployment. The results are discussed in relation to deployment-related policies and practices and their potential effects on the post-deployment health of female war service veterans.

METHODS

The surveillance period was 1 October 2001 through 31 December 2010. The surveillance population included all women who served in the active component of the Army, Navy, Air Force, Marine Corps, or Coast Guard and completed at least one OEF/OIF/OND deployment by 31 December 2009 (to allow 365 days for assessments of post-deployment health care).

Separate analyses were conducted of the post-deployment experiences of all

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14. ABSTRACT

Women account for approximately 10 percent of all U.S. military deployers to Afghanistan and Iraq. This analysis estimates the percentages of female deployers (n=154,548) who were affected by selected illnesses and injuries after first through third deployments to Iraq/Afghanistan in relation to age group, service branch, military occupation, marital status, pre-deployment medical history, ?dwell time? prior to 2nd and 3rd deployments, and length of deployment. Of these factors, diagnosis of a condition before deployment was by far the strongest predictor of diagnosis of the condition after deployment. Durations of dwell times before repeat deployments were not strong predictors of post-deployment diagnoses of any of the conditions considered. For several conditions (e.g., PTSD, disorders of joints, peripheral enthesopathies infertility), the percentages of deployers diagnosed with the conditions sharply increased with deployment length. Post-deployment morbidity moderately increased with increasing numbers of deployments in the case of some conditions (e.g., PTSD, migraine, musculoskeletal disorders), but not others. The findings suggest that limiting wartime deployments to nine months may have broad beneficial effects on the post-deployment health of female service members. However, limiting the number of wartime deployments and lengthening ?dwell times? before repeat deployments would likely not have strong and broad beneficial effects on the health of female veterans. Further research to mitigate the effects of heavy loads and repetitive stresses on the musculoskeletal systems of combat deployed females is indicated.

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female deployers after their first, second, and third OEF/OIF/OND deployments of at least 30 days each. Each member of each deployment-related cohort was characterized in relation to age group (<25 years, ≥25 years); military occupation (health care, other); marital status (married, other/unknown); service branch (Army, Navy, Air Force, Marine Corps, Coast Guard); time from the end of the prior to the beginning of second or third deployment (“dwell time”); and prior diagnosis of the condition of the interest (ever or never prior to deployment).

The endpoints of the three deployment-specific analyses were defined by illness-specific ICD-9-CM diagnostic codes (Table 1) that were recorded in any diagnostic position on standardized records of medical encounters (hospitalizations or ambulatory visits) within 365 days after completing the relevant OEF/OIF/OND deployment. Because of small numbers of cases, results for the Coast Guard and for chronic bronchitis are not summarized in this report. Results are available upon request to the MSMR editorial office (contact information on back cover).

For each illness-defined endpoint, the relative odds of a medical encounter for the condition post-deployment in relation to each demographic and military characteristic of interest were estimated by a logistic regression model that included a covariate for each characteristic. The independent effects of factors were considered nominally statistically significant if 95 percent confidence intervals around estimates of adjusted odds ratios excluded 1.0.

Tabular results related to diagnoses following first deployments are included in this article. Tables for second and third deployments (Tables 3a, 3b, 4a, 4b) are available as supplements at: http://www.afhsc.mil/viewMSMR?file=2012/v19_n07_sup_1.pdf.

RESULTS

During the surveillance period, 154,548 women in the active component of the U.S. Armed Forces deployed to and returned from Iraq or Afghanistan at least one time; of these, 47,848 (31.0%) deployed at least two times and 11,220 (7.3%) deployed at least three times.

TABLE 1. Illnesses of interest and indicator diagnostic codes (ICD-9-CM)

Mental disorders	
Episodic mood disorders	296.xx
Anxiety, dissociative and somatoform disorders	300.xx
Adjustment reaction (except PTSD)	309.xx (except 309.81)
Post-traumatic stress disorder (PTSD)	309.81
Special symptoms/syndromes (incl. nonorganic sleep disorders)	307.xx
Headaches	
Migraine	346.xx
Headache	784.0
Musculoskeletal disorders	
Intervertebral disc disorder	722.xx
Other disorders of cervical region	723.xx
Other/unspecified disorders of back	724.xx
Other/unspecified disorders of joint	719.xx
Peripheral enthesopathies, allied syndromes	726.xx
Reproductive system disorders	
Disorders of menstruation/other abnormal bleeding	626.xx
Female infertility	628.xx
Respiratory illnesses	
Chronic sinusitis	473.xx
Chronic bronchitis	491.xx
Asthma	493.xx

Mental disorders

Of the mental disorders considered here, the most frequently diagnosed were “adjustment reaction” and “anxiety, dissociative, and somatoform disorders.” Both conditions were diagnosed relatively more frequently after first than second or third deployments. “Episodic mood disorder” was the only condition for which the percentages affected monotonically declined with increasing deployments (Tables 2a, 3a, 4a, Figure 1a).

PTSD diagnoses consistently increased in relation to the percentages affected with increasing deployments. Also, PTSD and “special symptoms or syndromes” (which includes several sleep disorder-related conditions) were the only mental disorder diagnoses that affected larger percentages of third- than first-time deployers (Tables 2a, 3a, 4a, Figure 1a).

Among first-, second-, and third-time deployers, adjustment reaction and PTSD were much more frequently diagnosed when deployments were longer than 9 months. Thus, in regard to PTSD specifically, the percentage of deployers diagnosed with the condition increased in relation both to the number of prior deployments and to the duration of deployment – when it exceeded nine months (Figure 2).

Of the factors included in multivariate analyses, diagnosis of a condition before deployment was by far the strongest predictor of diagnosis of the condition after deployment. The strongest independent associations between pre-deployment and post-deployment diagnoses were for episodic mood disorder and PTSD. Thus, in analyses that controlled for the effects of all other factors of interest, deployers who were diagnosed with episodic mood disorder or PTSD before deployment were consistently seven to ten times more likely to be diagnosed with the respective conditions after deployment (adjusted odds ratio [AOR], range: episodic mood disorder, 8.16-9.15; PTSD, 7.13-9.53) (Tables 2a, 3a, 4a).

Other factors consistently associated with increased odds of mental disorder diagnoses after deployment were health care-related military occupation (particularly regarding diagnoses of PTSD and “special symptoms or syndromes”) and service in the Army (particularly regarding diagnoses of adjustment reaction in general and PTSD relative to Air Force and Navy members) (Tables 2a, 3a, 4a).

Of note, the durations of “dwell times” preceding second and third deployments were not strong or statistically significant determinants of risk of any mental disorder diagnoses considered here (Tables 2a, 3a, 4a).

Headaches

Two conditions with different patho-physiologic mechanisms but overlapping clinical expressions were considered in the analysis. From first through third deployments, the percentages diagnosed with “headache” remained stable (range, 7.42%-7.77%), while the percentages diagnosed with “migraine” consistently increased (range, 5.39%-6.31%) (Tables 2b, 3a, 4a, Figure 1b).

Diagnosis of migraine or headache before deployment was by far the strongest predictor of diagnosis of the respective condition after deployment; however, the magnitudes of these effects markedly differed between the conditions. For example, in analyses that controlled for the effects of all other factors, pre-deployment diagnosis increased the odds of post-deployment diagnosis (after first through third deployments) by 9- to 12-fold for migraine and 2.5- to 2.7-fold for headache (Tables 2b, 3a, 4a).

Following third deployments, more than one-fourth of those with pre-deployment diagnoses of migraine – compared to 3 percent of those without such histories – had post-deployment diagnoses of migraine; among third-time deployment veterans, those diagnosed with migraine before deployment accounted for approximately 60 percent of all migraine diagnoses after deployment (Table 4a).

In contrast, following third deployments, approximately 14 percent of those with pre-deployment diagnoses of headache – compared to 5.4 percent of those without such histories – had post-deployment diagnoses of headache; among third-time deployment veterans, those diagnosed with headache before deployment accounted for fewer than one-half (48.9%) of all headache diagnoses after deployment (Table 4a).

Other factors consistently associated with increased odds of migraine diagnoses after deployment were Army (particularly relative to Marine Corps) service and deployment longer than 9 months (Tables 2b, 3a, 4a).

Other factors consistently associated with increased odds of headache diagnoses post-deployment were younger age (<25 years), Army (particularly relative to Navy and Marine Corps) service, and deployment longer than 12 months (Tables 2b, 3a, 4a).

TABLE 2a. Diagnoses of mental disorders among female service members, after first OEF/OIF/OND deployments, active component, U.S. Armed Forces

	No. "at risk"	No. with diag	Mental disorders						
			Episodic mood			Anxiety, dissociative, somatoform			
			% with diag	Rel % (vs ref)	Adj OR (95% CI)	No. with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)
Total	154,548	4,604	2.98			8,286	5.36		
Age group (years)									
<25	86,368	2,526	2.92	ref	ref	4,643	5.38	ref	ref
≥25	68,180	2,078	3.05	1.04	0.84 (0.79, 0.90)	3,643	5.34	0.99	0.82 (0.78, 0.86)
Military occupation									
Health care	20,389	868	4.26	ref	ref	1,576	7.73	ref	ref
Other	134,159	3,736	2.78	0.64	0.72 (0.66, 0.78)	6,710	5.00	0.63	0.70 (0.66, 0.74)
Marital status									
Married	60,361	1,995	3.31	ref	ref	3,458	5.73	ref	ref
Other/unk	94,187	2,609	2.77	0.83	0.91 (0.85, 0.97)	4,828	5.13	0.89	0.97 (0.92, 1.01)
Service									
Army	63,933	2,448	3.83	ref	ref	4,521	7.07	ref	ref
Navy	38,581	729	1.89	0.48	0.52 (0.47, 0.57)	1,265	3.28	0.45	0.52 (0.48, 0.56)
Air Force	43,630	1,186	2.72	0.70	0.68 (0.62, 0.74)	2,139	4.90	0.68	0.73 (0.69, 0.78)
Marine Corps	8,170	234	2.86	0.74	0.81 (0.70, 0.94)	351	4.30	0.59	0.70 (0.63, 0.79)
History of condition									
Ever prior diag	varies by condition	998	16.91	8.19	8.16 (7.55, 8.82)	2,209	18.52	5.11	5.13 (4.86, 5.41)
Never prior diag		3,606	2.43	ref	ref	6,077	4.26	ref	ref
Deployment length									
<4 mos	32,204	921	2.86	ref	ref	1,422	4.42	ref	ref
4-6 mos	41,254	1,085	2.63	0.92	0.91 (0.83, 1.00)	1,958	4.75	1.08	1.07 (1.00, 1.15)
6-9 mos	39,855	1,075	2.70	0.94	0.97 (0.88, 1.06)	1,853	4.65	1.06	1.14 (1.06, 1.22)
9-12 mos	21,765	796	3.66	1.29	0.97 (0.88, 1.08)	1,546	7.10	1.66	1.31 (1.20, 1.42)
>12 mos	19,470	727	3.73	1.32	1.02 (0.91, 1.13)	1,507	7.74	1.82	1.45 (1.34, 1.57)

TABLE 2b. Diagnoses of headaches among female service members, after first OEF/OIF/OND deployments, active component, U.S. Armed Forces

	No. "at risk"	No. with diag	Headaches						
			Migraine			Headache			
			% with diag	Rel % (vs ref)	Adj OR (95% CI)	No. with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)
Total	154,548	8,326	5.39			12,003	7.77		
Age group (years)									
<25	86,368	4,033	4.67	ref	ref	6,862	7.95	ref	ref
≥25	68,180	4,293	6.30	1.37	0.92 (0.88, 0.97)	5,141	7.54	0.94	0.78 (0.75, 0.81)
Military occupation									
Health care	20,389	1,562	7.66	ref	ref	1,784	8.75	ref	ref
Other	134,159	6,764	5.04	0.64	0.84 (0.79, 0.89)	10,219	7.62	0.86	0.94 (0.89, 0.99)
Marital status									
Married	60,361	3,883	6.43	ref	ref	5,079	8.41	ref	ref
Other/unk	94,187	4,443	4.72	0.72	0.89 (0.85, 0.93)	6,924	7.35	0.86	0.94 (0.90, 0.98)
Service									
Army	63,933	4,155	6.50	ref	ref	6,288	9.84	ref	ref
Navy	38,581	1,314	3.41	0.51	0.58 (0.54, 0.63)	1,709	4.43	0.42	0.47 (0.44, 0.50)
Air Force	43,630	2,618	6.00	0.92	0.89 (0.83, 0.95)	3,618	8.29	0.83	0.86 (0.81, 0.90)
Marine Corps	8,170	235	2.88	0.43	0.55 (0.48, 0.63)	376	4.60	0.44	0.49 (0.44, 0.54)
History of condition									
Ever prior diag	varies by condition	3,559	25.20	9.59	9.29 (8.84, 9.76)	4,336	14.31	2.54	2.49 (2.39, 2.59)
Never prior diag		4,767	3.39	ref	ref	7,667	6.17	ref	ref
Deployment length									
<4 mos	32,204	1,556	4.83	ref	ref	2,282	7.1	ref	ref
4-6 mos	41,254	2,182	5.29	1.10	1.04 (0.97, 1.12)	3,091	7.5	1.06	1.07 (1.01, 1.13)
6-9 mos	39,855	1,841	4.62	0.95	1.06 (0.99, 1.14)	2,638	6.6	0.93	1.05 (0.99, 1.12)
9-12 mos	21,765	1,465	6.73	1.42	1.24 (1.14, 1.35)	2,098	9.6	1.40	1.13 (1.05, 1.20)
>12 mos	19,470	1,282	6.58	1.39	1.21 (1.11, 1.32)	1,894	9.7	1.41	1.16 (1.08, 1.24)

TABLE 2a. continued

Mental disorders (cont'd)											
Adjustment reaction				PTSD				Special symptoms or syndromes			
No.with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)	No.with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)	No.with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)
10,956	7.09			2,827	1.83			4,648	3.01		
6,501	7.53	ref	ref	1,566	1.81	ref	ref	2,490	2.88	ref	ref
4,455	6.53	0.86	0.75 (0.72,0.78)	1,261	1.85	1.02	0.90 (0.84,0.98)	2,158	3.17	1.10	0.97 (0.91,1.03)
1,995	9.78	ref	ref	681	3.34	ref	ref	902	4.42	ref	ref
8,961	6.68	0.66	0.70 (0.67,0.74)	2,146	1.60	0.47	0.48 (0.43,0.52)	3,746	2.79	0.62	0.69 (0.64,0.74)
4,623	7.66	ref	ref	1,164	1.93	ref	ref	1,872	3.10	ref	ref
6,333	6.72	0.87	0.90 (0.87,0.94)	1,663	1.77	0.91	0.97 (0.90,1.05)	2,776	2.95	0.95	1.06 (0.99,1.12)
6,958	10.88	ref	ref	1,798	2.81	ref	ref	2,562	4.01	ref	ref
1,295	3.36	0.28	0.34 (0.32,0.36)	371	0.96	0.34	0.42 (0.37,0.47)	587	1.52	0.37	0.42 (0.38,0.47)
2,354	5.40	0.47	0.52 (0.49,0.55)	492	1.13	0.39	0.52 (0.47,0.59)	1,347	3.09	0.76	0.84 (0.77,0.91)
338	4.14	0.35	0.42 (0.38,0.48)	162	1.98	0.70	0.91 (0.77,1.08)	148	1.81	0.44	0.53 (0.45,0.63)
2,658	17.08	3.24	3.03 (2.89,3.18)	214	13.89	9.29	9.53 (8.18,11.11)	861	8.47	3.43	3.25 (3.00,3.51)
8,298	5.97	ref	ref	2,613	1.71	ref	ref	3,787	2.62	ref	ref
1,790	5.56	ref	ref	355	1.10	ref	ref	800	2.48	ref	ref
2,367	5.74	1.03	1.09 (1.03,1.17)	509	1.23	1.12	1.17 (1.02,1.34)	1,118	2.71	1.09	1.09 (0.99,1.20)
2,254	5.66	1.02	1.11 (1.04,1.19)	675	1.69	1.55	1.57 (1.38,1.80)	1,011	2.54	1.02	1.17 (1.06,1.28)
2,278	10.47	1.99	1.25 (1.17,1.34)	605	2.78	2.57	1.73 (1.50,2.00)	902	4.14	1.70	1.35 (1.22,1.51)
2,267	11.64	2.24	1.45 (1.35,1.55)	683	3.51	3.26	2.24 (1.95,2.57)	817	4.20	1.72	1.36 (1.22,1.51)

Musculoskeletal conditions:

For each of the five musculoskeletal disorders considered here, the percentages of deployers diagnosed with the conditions increased as the number of deployments increased (Figure 1c). For each of the conditions, diagnosis before deployment was the strongest predictor of diagnosis after deployment; however, the magnitudes of these effects markedly varied among the conditions. For example, in multivariate analyses, pre-deployment diagnosis increased the odds of post-deployment diagnosis (after first through third deployments) by 14- to 16-fold for “intervertebral disc disorders,” 4- to 5-fold for “other disorders of the cervical region,” and 2- to 3-fold for “other derangements of joints,” “other/unspecified disorders of the back,” and “peripheral enthesopathies” (Tables 2c, 3b, 4b).

Other factors consistently associated with increased odds of “intervertebral disc disorder” diagnoses post-deployment were Army (particularly relative to Navy and Marine Corps) service and deployment

longer than 12 months (although the effect of length of deployment was not nominally statistically significant in all multivariate analyses) (Tables 2c, 3b, 4b, Figure 3a).

Older age (>25 years) and Army (particularly relative to Navy and Marine Corps) service were factors – other than pre-deployment diagnosis – that were consistently associated with increased risk of post-deployment diagnosis of “other disorders of the cervical region.” The relationship between deployment duration and risk of post-deployment diagnosis was not as strong or consistent for “other disorders of the cervical region” as for the other musculoskeletal disorders considered here (Tables 2c, 3b, 4b Figure 3b).

The percentages of deployers diagnosed with “other/unspecified disorders of the back” were markedly higher when deployments were longer than 9 months (Figure 3a). In multivariate analyses, Army (particularly relative to Navy and Marine Corps) service and deployment duration were the only factors other than pre-deployment diagnosis that were consistently associated with

increased odds of post-deployment diagnosis of “other/unspecified disorders of the back.” Of note, after first, second, and third deployments, more than one-fifth (range, 21.4%-23.2%) of all female Army deployers were diagnosed with “other/unspecified disorders of the back” (Tables 2c, 3b, 4b).

The percentages of deployers diagnosed with “other derangement of joints” generally increased in relation to the durations of deployments; percentages were particularly high after deployments longer than nine months (Figure 3a). In multivariate analyses, older age (>25 years), Army (particularly relative to Navy and Marine Corps) service, and deployment duration were factors other than pre-deployment diagnosis that were consistently associated with increased odds of post-deployment diagnosis of “other derangement of joints.” Of note, after first, second, and third deployments, more than one-fourth (range, 27.3%-30.3%) of all female Army deployers were diagnosed with “other derangement of joints” (Tables 2c, 3b, 4b).

The percentages of deployers diagnosed with “peripheral enthesopathy” generally increased in relation to the durations of deployments; percentages were particularly high after deployments that were longer than 9 months (Figure 3b). In multivariate analyses, older age (>25 years), Army (particularly relative to Navy and Marine Corps) service, and deployment duration were factors other than pre-deployment diagnosis that were consistently associated with increased odds of post-deployment diagnosis of “peripheral enthesopathy” (Tables 2c, 3b, 4b).

Reproductive system disorders

The percentages of deployers diagnosed with “infertility” slightly increased (range, 2.0%-2.8%), while the percentages diagnosed with “disorders of menstruation” remained stable (range, 7.6%-8.0%), with increasing number of deployments (Tables 2d, 3b, 4b, Figure 1d).

For each reproductive system disorder considered here, diagnosis before deployment was the strongest independent predictor of diagnosis of the condition after deployment; however, the magnitudes of the effects markedly varied between the conditions. For example, in multivariate analyses,

pre-deployment diagnosis increased the odds of post-deployment diagnosis after first through third deployments by 10- to 12-fold for “infertility” but 2.1- to 2.7-fold for “disorders of menstruation” (Tables 2d, 3b, 4b).

As for many other conditions considered here, the percentages of deployers diagnosed with “infertility” were markedly higher among those deployed longer than 9 months (Figure 4). In multivariate analyses, currently married, Army (particularly relative to Navy and Marine Corps) service, and deployment duration were factors other than pre-deployment diagnosis that were consistently associated with increased odds of post-deployment diagnosis of “infertility.” Of interest, a longer “dwell time” before a second (but not third) deployment was a statistically significant independent predictor of diagnosis of “infertility” after deployment (Tables 2d, 3b, 4b).

The percentages of deployers diagnosed with “disorders of menstruation” were generally higher among those deployed longer than nine months (Figure 4). In multivariate analyses, currently married, Army (particularly relative to Navy and Marine Corps) service, and deployment duration were factors other than pre-deployment diagnosis that were consistently associated with increased odds of post-deployment diagnosis of “disorders of menstruation” (Tables 2d, 3b, 4b).

Respiratory disorders

The percentages of deployers diagnosed with “chronic sinusitis” markedly increased (range, 2.9%-3.8%), while the percentages diagnosed with “asthma” slightly declined (range, 2.8%-2.6%), with increasing number of deployments (Tables 2e, 3b, 4b, Figure 1e).

For each respiratory system disorder considered here, diagnosis before deployment was the strongest independent predictor of diagnosis of the condition after deployment; again, however, the magnitudes of the effects markedly varied between the conditions. For example, in multivariate analyses, pre-deployment diagnosis increased the odds of post-deployment diagnosis after first through third deployments by 14- to 17-fold for

TABLE 2c. Diagnoses of musculoskeletal conditions among female service members, after first OEF/OIF/OND deployments, active component, U.S. Armed Forces

	Musculoskeletal conditions								
	No. "at risk"	No. with diag	Intervertebral disk			Other disorders of cervical region			
% with diag			Rel % (vs ref)	Adj OR (95% CI)	No. with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)	
Total	154,548	3,245	2.10			6,021	3.90		
Age group (years)									
<25	86,368	951	1.10	ref	ref	2,464	2.85	ref	ref
≥25	68,180	2,294	3.36	3.13	1.12 (0.90,1.38)	3,557	5.22	1.87	1.47 (1.39,1.56)
Military occupation									
Health care	20,389	598	2.93	ref	ref	1,092	5.36	ref	ref
Other	134,159	2,647	1.97	0.67	0.96 (0.80,1.15)	4,929	3.67	0.67	0.84 (0.78,0.90)
Marital status									
Married	60,361	1,615	2.68	ref	ref	2,704	4.48	ref	ref
Other/unk	94,187	1,630	1.73	0.64	0.93 (0.80,1.08)	3,317	3.52	0.78	0.99 (0.94,1.04)
Service									
Army	63,933	1,968	3.08	ref	ref	3,007	4.70	ref	ref
Navy	38,581	394	1.02	0.32	0.59 (0.47,0.74)	808	2.09	0.43	0.52 (0.48,0.57)
Air Force	43,630	788	1.81	0.58	0.76 (0.62,0.93)	2,033	4.66	0.99	1.01 (0.94,1.08)
Marine Corps	8,170	89	1.09	0.35	0.77 (0.51,1.16)	164	2.01	0.42	0.54 (0.46,0.64)
History of condition									
Ever prior diag	varies by	919	23.17	19.22	14.34 (13.12,15.67)	1,573	13.24	4.74	4.00 (3.75,4.26)
Never prior diag	condition	2,326	1.54	ref	ref	4,448	3.12	ref	ref
Deployment length									
<4 mos	32,204	501	1.56	ref	ref	1,095	3.40	ref	ref
4-6 mos	41,254	753	1.83	1.18	1.20 (0.95,1.51)	1,637	3.97	1.17	1.13 (1.05,1.23)
6-9 mos	39,855	691	1.73	1.12	1.24 (0.98,1.56)	1,282	3.22	0.94	1.10 (1.01,1.20)
9-12 mos	21,765	681	3.13	2.04	1.02 (0.78,1.35)	1,028	4.72	1.41	1.28 (1.17,1.41)
>12 mos	19,470	619	3.18	2.08	1.24 (0.94,1.62)	979	5.03	1.5	1.36 (1.24,1.50)

TABLE 2d. Diagnoses of reproductive system disorders among female service members, after first OEF/OIF/OND deployments, active component, U.S. Armed Forces

	Reproductive system disorders								
	No. "at risk"	No. with diag	Menstruation			Infertility			
% with diag			Rel % (vs ref)	Adj OR (95% CI)	No. with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)	
Total	154,548	12,306	7.96			3,098	2.00		
Age group (years)									
<25	86,368	7,007	8.11	ref	ref	1,201	1.39	ref	ref
≥25	68,180	5,299	7.77	0.95	0.81 (0.78,0.84)	1,897	2.78	2.03	1.09 (1.00,1.18)
Military occupation									
Health care	20,389	1,669	8.19	ref	ref	535	2.62	ref	ref
Other	134,159	10,637	7.93	0.97	1.02 (0.97,1.08)	2,563	1.91	0.72	0.93 (0.84,1.02)
Marital status									
Married	60,361	5,306	8.79	ref	ref	2,085	3.45	ref	ref
Other/unk	94,187	7,000	7.43	0.83	0.90 (0.86,0.93)	1,013	1.08	0.30	0.43 (0.40,0.47)
Service									
Army	63,933	5,766	9.02	ref	ref	1,708	2.67	ref	ref
Navy	38,581	2,011	5.21	0.55	0.62 (0.58,0.65)	503	1.30	0.48	0.67 (0.60,0.75)
Air Force	43,630	4,048	9.28	1.03	1.08 (1.03,1.14)	790	1.81	0.67	0.75 (0.67,0.83)
Marine Corps	8,170	458	5.61	0.60	0.65 (0.59,0.72)	95	1.16	0.43	0.62 (0.50,0.77)
History of condition									
Ever prior diag	varies by	4,214	13.23	2.16	2.12 (2.04,2.21)	991	16.76	14.00	10.50 (9.63,11.46)
Never prior diag	condition	8,092	6.60	ref	ref	2,107	1.42	ref	ref
Deployment length									
<4 mos	32,204	2,363	7.34	ref	ref	490	1.52	ref	ref
4-6 mos	41,254	3,284	7.96	1.09	1.08 (1.02,1.14)	767	1.86	1.23	1.23 (1.09,1.38)
6-9 mos	39,855	2,823	7.08	0.96	1.10 (1.04,1.16)	661	1.66	1.09	1.16 (1.03,1.31)
9-12 mos	21,765	1,958	9.00	1.25	1.20 (1.12,1.28)	609	2.80	1.86	1.62 (1.41,1.85)
>12 mos	19,470	1,878	9.65	1.35	1.29 (1.20,1.38)	571	2.93	1.96	1.71 (1.49,1.95)

TABLE 2c. continued

Musculoskeletal conditions (cont'd)											
Other back				Other joint				Peripheral enthesopathy			
No. with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)	No. with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)	No. with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)
24,616	15.93			29,936	19.37			9,733	6.30		
13,026	15.08	ref	ref	14,947	17.31	ref	ref	4,244	4.91	ref	ref
11,590	17.00	1.15	0.92 (0.89,0.94)	14,989	21.98	1.35	1.19 (1.16,1.22)	5,489	8.05	1.69	1.48 (1.42,1.55)
3,493	17.13	ref	ref	4,360	21.38	ref	ref	1,574	7.72	ref	ref
21,123	15.74	0.90	0.99 (0.95,1.03)	25,576	19.06	0.87	0.96 (0.92,1.00)	8,159	6.08	0.77	0.90 (0.85,0.95)
10,525	17.44	ref	ref	12,497	20.70	ref	ref	4,177	6.92	ref	ref
14,091	14.96	0.83	0.96 (0.93,0.99)	17,439	18.52	0.87	1.03 (1.00,1.06)	5,556	5.90	0.84	1.04 (0.99,1.08)
13,832	21.64	ref	ref	17,438	27.28	ref	ref	5,454	8.53	ref	ref
3,206	8.31	0.33	0.41 (0.39,0.43)	3,332	8.64	0.25	0.37 (0.35,0.38)	1,203	3.12	0.35	0.44 (0.41,0.47)
6,673	15.29	0.65	0.75 (0.72,0.78)	7,965	18.26	0.60	0.80 (0.77,0.83)	2,662	6.10	0.70	0.84 (0.79,0.89)
883	10.81	0.44	0.54 (0.50,0.58)	1,176	14.39	0.45	0.57 (0.54,0.61)	405	4.96	0.56	0.67 (0.60,0.75)
12,463	26.14	2.76	2.52 (2.45,2.60)	19,248	28.65	2.88	2.33 (2.27,2.40)	3,902	11.77	2.64	2.28 (2.18,2.38)
12,153	11.37	ref	ref	10,688	12.23	ref	ref	5,831	4.80	ref	ref
4,397	13.65	ref	ref	4,793	14.88	ref	ref	1,640	5.09	ref	ref
5,972	14.48	1.07	1.10 (1.05,1.15)	7,229	17.52	1.22	1.24 (1.19,1.30)	2,380	5.77	1.14	1.15 (1.08,1.23)
5,405	13.56	0.99	1.13 (1.08,1.18)	6,453	16.19	1.1	1.27 (1.22,1.32)	2,114	5.30	1.04	1.18 (1.10,1.26)
4,662	21.42	1.72	1.25 (1.19,1.31)	6,008	27.60	2.18	1.48 (1.41,1.55)	1,924	8.84	1.81	1.38 (1.28,1.48)
4,180	21.47	1.73	1.28 (1.22,1.35)	5,453	28.01	2.22	1.55 (1.48,1.63)	1,675	8.60	1.75	1.36 (1.26,1.47)

TABLE 2e. Diagnoses of respiratory disorders among female service members, after first OEF/OIF/OND deployments, active component, U.S. Armed Forces

	Respiratory disorders							
	Sinus				Asthma			
	No. with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)	No. with diag	% with diag	Rel % (vs ref)	Adj OR (95% CI)
Total	4,525	2.93			4,393	2.84		
Age group (years)								
<25	2,072	2.40	ref	ref	2,376	2.75	ref	ref
≥25	2,453	3.60	1.52	1.21 (1.14,1.29)	2,017	2.96	1.08	0.84 (0.79,0.90)
Military occupation								
Health care	800	3.92	ref	ref	607	2.98	ref	ref
Other	3,725	2.78	0.70	0.87 (0.80,0.94)	3,786	2.82	0.95	1.08 (0.98,1.18)
Marital status								
Married	2,075	3.44	ref	ref	1,799	2.98	ref	ref
Other/unk	2,450	2.60	0.75	0.90 (0.85,0.96)	2,594	2.75	0.92	1.03 (0.96,1.10)
Service								
Army	2,232	3.49	ref	ref	2,911	4.55	ref	ref
Navy	554	1.44	0.40	0.50 (0.45,0.56)	718	1.86	0.40	0.51 (0.47,0.56)
Air Force	1,617	3.71	1.06	1.20 (1.10,1.30)	589	1.35	0.29	0.44 (0.39,0.48)
Marine Corps	109	1.33	0.37	0.48 (0.39,0.58)	172	2.11	0.45	0.58 (0.49,0.69)
History of condition								
Ever prior diag	1,118	8.93	3.99	3.42 (3.19,3.68)	1,974	21.91	16.60	15.03 (14.07,16.06)
Never prior diag	3,407	2.40	ref	ref	2,419	1.66	ref	ref
Deployment length								
<4 mos	719	2.23	ref	ref	711	2.21	ref	ref
4-6 mos	1,299	3.15	1.42	1.36 (1.24,1.49)	862	2.09	0.95	1.06 (0.96,1.18)
6-9 mos	963	2.42	1.08	1.31 (1.18,1.44)	984	2.47	1.12	1.09 (0.98,1.21)
9-12 mos	824	3.79	1.72	1.63 (1.45,1.82)	1,008	4.63	2.15	1.29 (1.15,1.43)
>12 mos	720	3.70	1.68	1.55 (1.38,1.73)	828	4.25	1.97	1.19 (1.06,1.33)

“asthma” but 3.2- to 3.6-fold for “chronic sinusitis” (Tables 2e, 3b, 4b).

In multivariate analyses, older age (>25 years), health care occupation (statistically significant after first and third deployments only), Air Force (relative to Navy and Marine Corps) service, and deployment duration were factors other than pre-deployment diagnosis that were consistently associated with increased odds of post-deployment diagnosis of “chronic sinusitis” (Tables 2e, 3b, 4b).

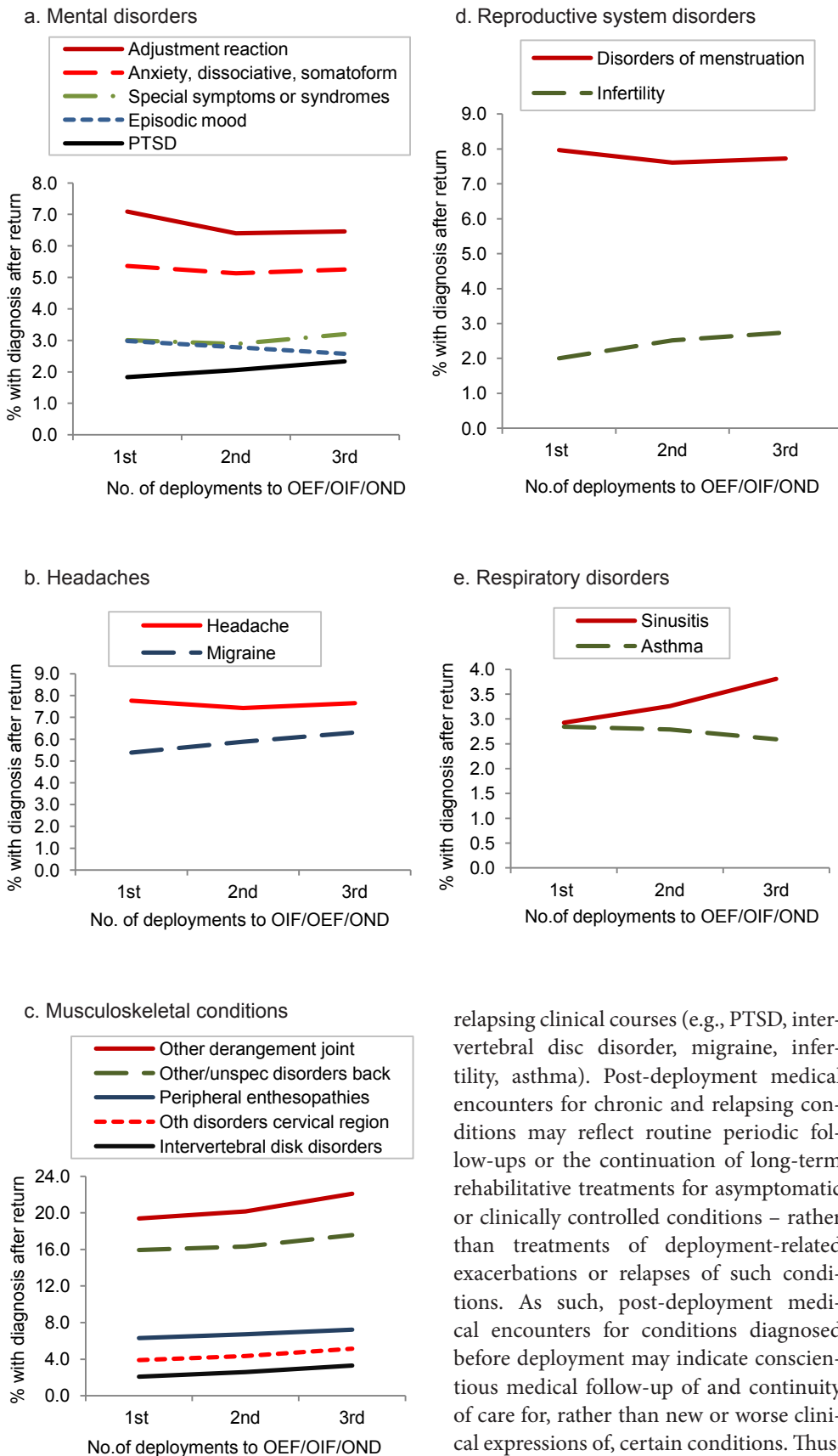
In multivariate analyses, younger age (after first and second deployments), Army (particularly in relation to Air Force) service, and deployment duration were factors other than pre-deployment diagnosis that were consistently associated with increased odds of post-deployment diagnosis of “asthma” (Tables 2e, 3b, 4b).

EDITORIAL COMMENT

This report extends the findings of previous MSMR reports regarding threats to the health of women in relation to war-time military service. The report focuses on conditions that were identified as “relatively excessive” in previous analyses of the post-deployment experiences of recently deployed female service members. While the conditions considered here are a select few, they do affect diverse organ systems and physiologic functions and have various underlying causes, pathophysiologic mechanisms, exacerbating factors, clinical manifestations, clinical courses (e.g., acute, chronic, relapsing), and epidemiologic characteristics. As such, they are a broad and diverse representation of the clinical expressions of threats to the health of women who participate in warfighting.

For each of the conditions considered here, the strongest independent predictor of diagnosis of the condition after deployment was diagnosis of the condition before deployment. The finding has been documented previously among both male and female participants in warfighting and peacekeeping operations.¹¹⁻¹³ Of note, in this analysis, the strengths of the associations between ever prior diagnoses and post-deployment diagnoses of various conditions markedly varied; the largest effects were related to conditions with chronic or

FIGURE 1. Percentages of female deployers diagnosed with selected conditions after returning from deployment to OIF/OEF/OND, by the number of deployment, active component, U.S. Armed Forces



the clinical impacts of combat deployments on the courses of chronic and relapsing illnesses are not reflected reliably by the strengths of associations between pre- and post-deployment medical encounters for the conditions.

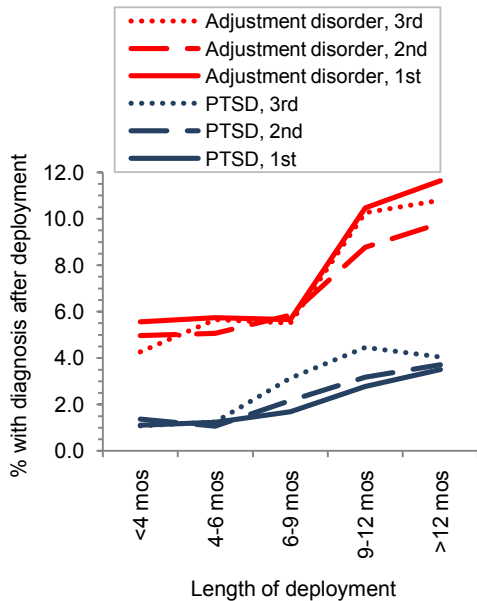
The other factor that was consistently a strong independent predictor of diagnoses of conditions after deployment was service in the Army – particularly in relation to the Navy and Marine Corps. Of note in this regard, women in the Air Force were significantly more likely than those in the Army or other Services to be diagnosed with chronic sinusitis after first and second wartime deployments. It seems unlikely that female members of the Army versus those of the other service branches are truly at higher risk of clinically significant mental, musculoskeletal, reproductive system, and respiratory disorders as well as headaches (including migraines) after wartime service in the same geographic regions. The finding may reflect differences in duty assignments and experiences during deployments, the natures and completeness of post-deployment medical assessments and follow-ups, and/or the completeness and accuracy of coding and reporting diagnoses in the administrative medical records used for analysis. Whatever the case, the finding deserves further investigation.

In general, after deployments, women in health care versus other military occupations were significantly more likely to be diagnosed with mental disorders – particularly PTSD and “special symptoms/syndromes” (which includes various sleep disorders) – but not the other conditions of interest for this report. The finding likely reflects the unique and unrelenting psychological stresses inherent to the delivery of health care during war – as well perhaps decreased barriers to and stigmas associated with seeking mental health care and better access to mental health services by health care workers after deployments.

The findings regarding relationships between post-deployment diagnoses of various conditions and the number of prior deployments, the durations of deployments, and times from the end of preceding to the start of second and third deployments (“dwell times”) are informative. For example, in multivariate analyses that controlled for the effects

relapsing clinical courses (e.g., PTSD, intervertebral disc disorder, migraine, infertility, asthma). Post-deployment medical encounters for chronic and relapsing conditions may reflect routine periodic follow-ups or the continuation of long-term rehabilitative treatments for asymptomatic or clinically controlled conditions – rather than treatments of deployment-related exacerbations or relapses of such conditions. As such, post-deployment medical encounters for conditions diagnosed before deployment may indicate conscientious medical follow-up of and continuity of care for, rather than new or worse clinical expressions of, certain conditions. Thus,

FIGURE 2. Percentages of female deployers diagnosed with adjustment disorder or post-traumatic stress disorder (PTSD) after deployment, by the number and length of deployment, active component, U.S. Armed Forces



of all other factors of interest, the durations of dwell times before repeat deployments were not strong independent predictors of post-deployment diagnoses of any of the conditions considered here – including mental disorders. The small and statistically insignificant associations between the durations of dwell times before and diagnoses of mental disorders and selected other conditions after

repeat deployments suggest that lengthening dwell times before repeat wartime deployments would have minimal impacts, if any, on the incidence of mental disorders or any other conditions among female deployers. It should be noted, however, that analyses for this report compared post-deployment experiences after dwell times longer versus shorter than six months; the beneficial effects of dwell times much longer than six months may not have been detectable by the analyses.

The findings regarding “dose response” relationships between the lengths of deployments and diagnoses of various conditions after deployments are also informative. For most conditions, the percentages of deployers diagnosed with the conditions increased as deployment times lengthened; and for several conditions (e.g., PTSD, disorders of joints, peripheral enthesopathies, infertility), the percentages of deployers diagnosed with the conditions sharply increased to the extent that deployments were longer than nine months. The findings suggest that limiting wartime deployments to nine months may have broad beneficial effects on the post-deployment health – particularly, the mental, musculoskeletal, and reproductive health – of female service members.

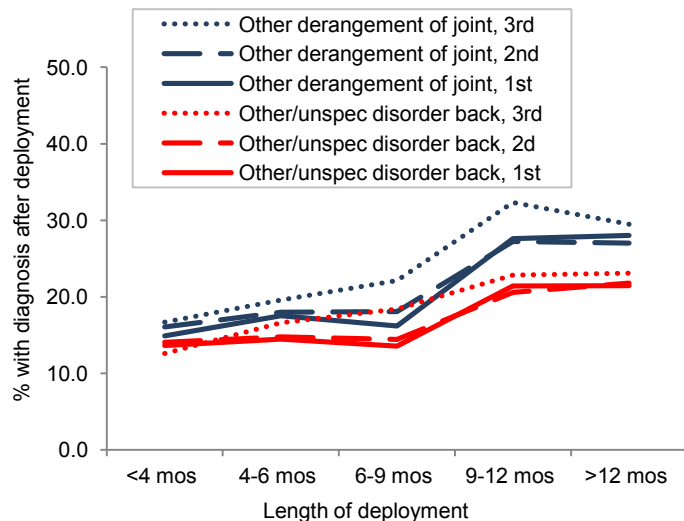
The findings regarding relationships between the number of war-related deployments and diagnoses of various conditions after deployments are also informative. For PTSD, migraine, infertility,

chronic sinusitis, and each of the musculoskeletal disorders considered here, the percentages of deployers diagnosed with the conditions monotonically increased with increasing numbers of deployments. However, for all but one (“mental disorder, special symptoms or syndromes”) of the other conditions of interest, smaller percentages of deployers were diagnosed with the conditions after second and third than first deployments. The findings suggest that limiting the number of wartime deployments of female service members may decrease post-deployment morbidity related to PTSD, musculoskeletal disorders – particularly, back, neck, and joints – and selected other conditions; however, such a policy would likely not have strong and broad beneficial effects on the health of female deployment veterans. Further research of policies, practices, and equipment that would decrease or mitigate the effects of heavy loads and repetitive stresses on the musculoskeletal systems – particularly the lower backs, necks, and joints – of combat deployed females is indicated.

The findings of this report reiterate the importance of multivariate analyses for reliably estimating the natures and strengths of the effects of factors of hypothesized importance on the post-deployment health of female deployment veterans. For example, after second and third deployments, the percentages of women diagnosed with infertility were 82

FIGURE 3. Percentages of female deployers diagnosed with selected musculoskeletal conditions after deployment, by the number and length of deployment, active component, U.S. Armed Forces

a. Other derangement of joints, other unspecified disorders of back



b. Intervertebral disc disorders (IDD), other disorders of cervical region (other), peripheral enthesopathies (PE)

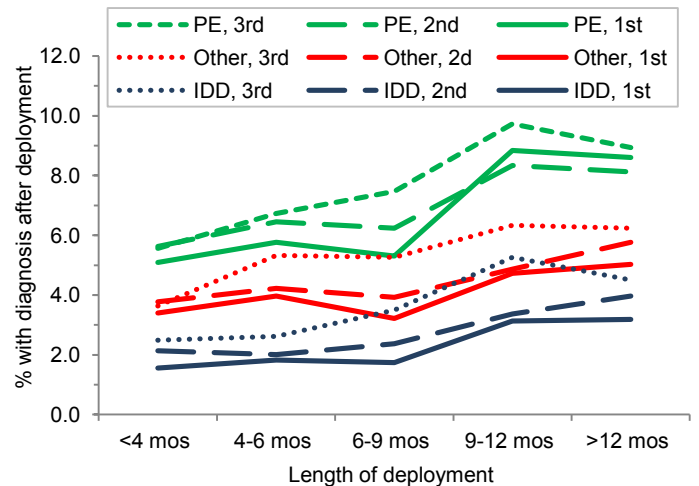
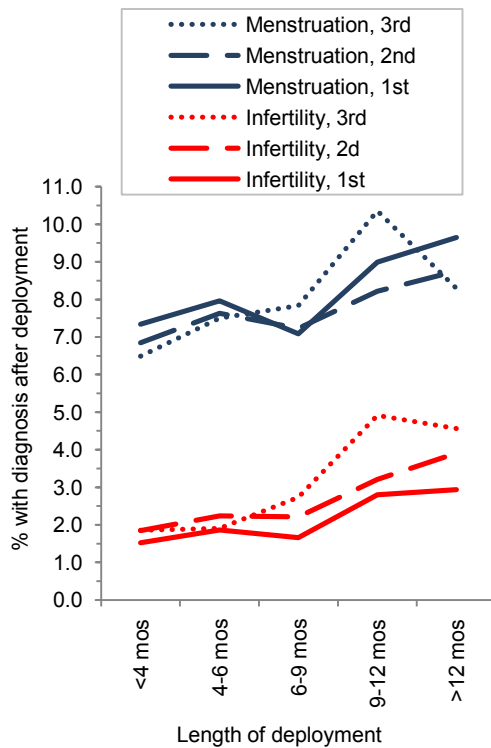


FIGURE 4. Percentages of female deployers diagnosed with “disorders of menstruation” or “infertility” after deployment, by the number and length of deployment, active component, U.S. Armed Forces



percent and 63 percent higher, respectively, among those older than 25 years. However, in multivariate analyses that controlled for the confounding effects of other factors of interest, age group had almost no independent predictive effect on diagnosis of infertility after second or third deployments (adjusted odds ratio, 2nd deployment, 1.03 [0.90, 1.19]; 3rd deployment, 0.99 [0.73, 1.34]). Also, for example, after first deployments, the percentage of women diagnosed with disorders of the back was 15 percent higher among those older than 25 years. However, in multivariate analysis, older age had a statistically significant protective effect on post-deployment diagnosis of disorders of the back (adjusted odds ratio, 0.92 [0.89, 0.94]). Clearly, causal inferences and policy-making decisions should not be based on crude (i.e., not adjusted for confounding effects) estimates of the effects of specific factors.

The limitations of these analyses should be considered when interpreting the results. For example, the analyses were

limited to conditions that were previously identified as “excessive” among female active component members after OIF/OEF/OND deployments; as such, the results may not be generalizable to conditions not considered here, to reserve component members or women who have left active service soon after returning from deployment, or to wartime deployments at other times, of other types, or in other settings.

Also, the endpoints of analyses were ICD-9-CM diagnostic codes (recorded in any diagnostic position on an administrative record of a medical encounter) that are indicators of the conditions of interest for this report. However, some of the ICD-9-CM indicator diagnoses used here are non-specific (e.g., mental disorder: ICD-9-CM: 307 “special symptoms or syndromes, not elsewhere classified”; musculoskeletal disorder: 719 “other/unspecified disorders of joint”); and some diagnoses recorded on administrative medical records – particularly those not recorded as primary (first-listed) diagnoses – may not specify confirmed diagnoses (e.g., suspected or “rule out” diagnoses) or currently symptomatic disease (e.g., post-treatment follow-up of previously active disease). Finally, the diagnostic codes used as endpoints of analyses do not specify the clinical severity of the conditions of interest.

In summary, the findings of this report suggest that limiting the durations (e.g., to less than nine months each) of wartime deployments would likely have beneficial effects on the health of female wartime deployment veterans – particularly in relation to PTSD, musculoskeletal disorders, and reproductive system disorders. In contrast, neither the number of deployments nor the durations of dwell times before repeat (second and third) deployments were strong and consistent predictors of post-deployment morbidity; as such, policies that would limit the number of wartime deployments per individual or require long dwell times before repeat deployments would likely not have broad beneficial effects on the post-deployment health of female deployment veterans. Finally, policies regarding the health effects of wartime service should consider and account for the effects of other relevant factors.

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