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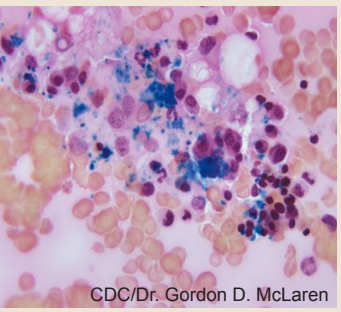

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Health of Women after Wartime Deployments: Correlates of Risk for Selected Medical Conditions among Females after Initial and Repeat Deployments to Afghanistan and Iraq, Active Component, U.S. Armed Forces

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

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 pathophysiologic 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

		Mental disorders							
		Episodic mood				Anxiety, dissociative, somatoform			
	No. "at risk"	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	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

		Headaches							
		Migraine				Headache			
	No. "at risk"	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	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" 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" 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							
		Intervertebral disk				Other disorders of cervical region			
	No. "at risk"	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	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							
		Menstruation				Infertility			
	No. "at risk"	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	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 condition	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		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)**.

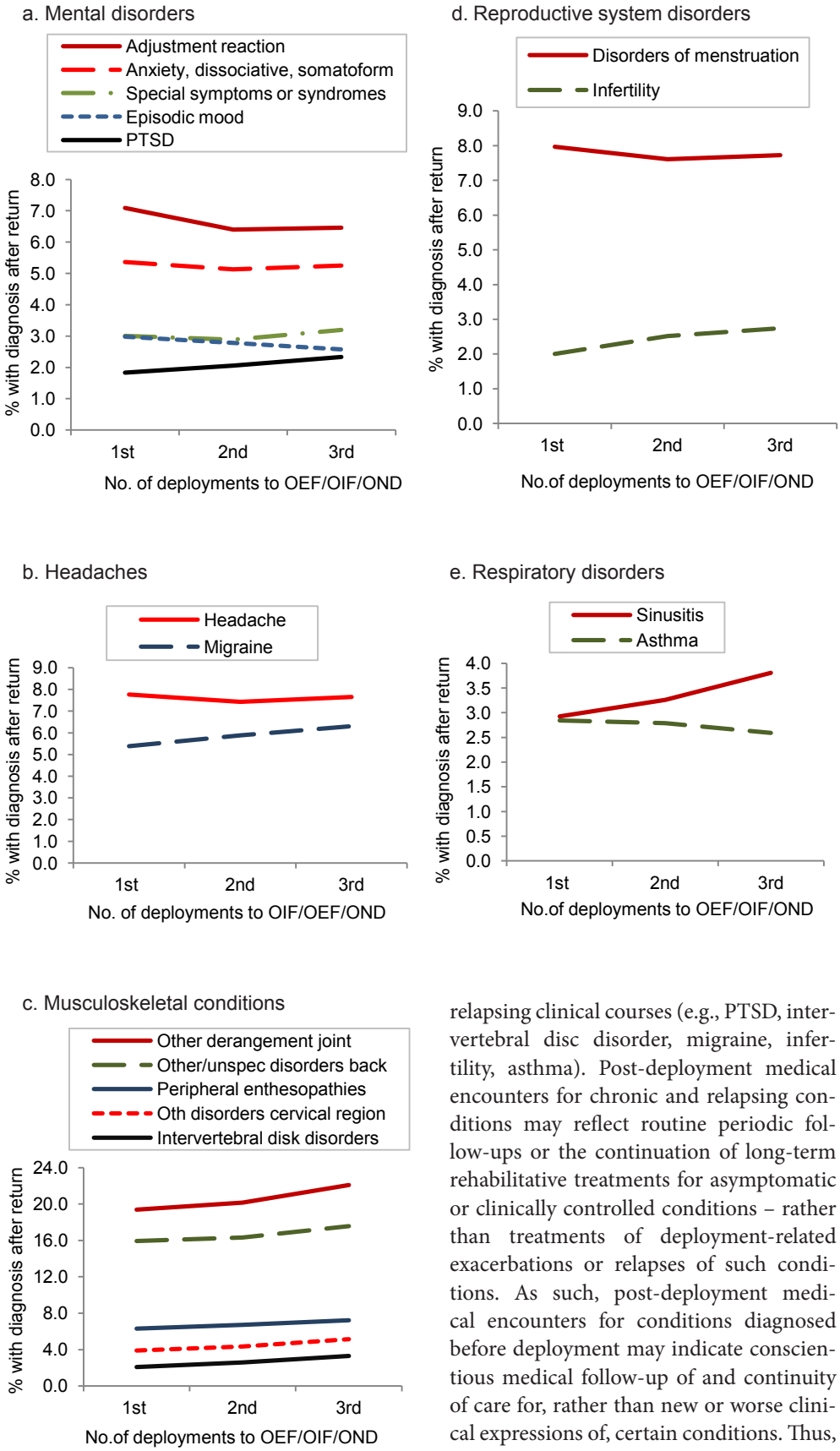
In multivariate analyses, younger age (after first and second deployments), Army (particularly in relation to Air Force) service, and deployment duration were factors other than pre-deployment diagnosis that were consistently associated with increased odds of post-deployment diagnosis of "asthma" **(Tables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

EDITORIAL COMMENT

This report extends the findings of previous *MSMR* reports regarding threats to the health of women in relation to wartime 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



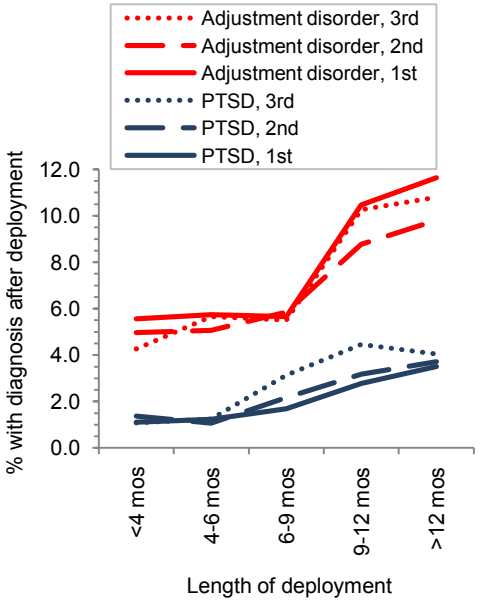
relapsing clinical courses (e.g., PTSD, intervertebral disc disorder, migraine, infertility, asthma). Post-deployment medical encounters for chronic and relapsing conditions may reflect routine periodic follow-ups or the continuation of long-term rehabilitative treatments for asymptomatic or clinically 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, 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

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.

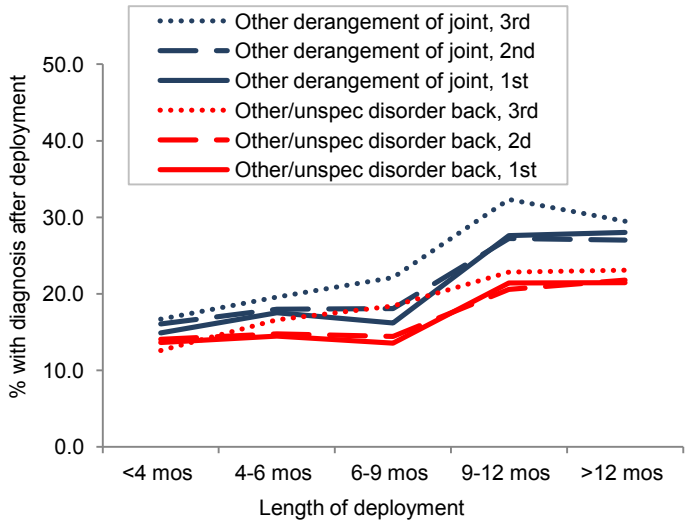
The findings regarding "dose response" relationships between the lengths of deployments and diagnoses of various conditions after deployments are also informative. For most conditions, the percentages of deployers diagnosed with the conditions increased as deployment times lengthened; and for several conditions (e.g., PSTD, 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)

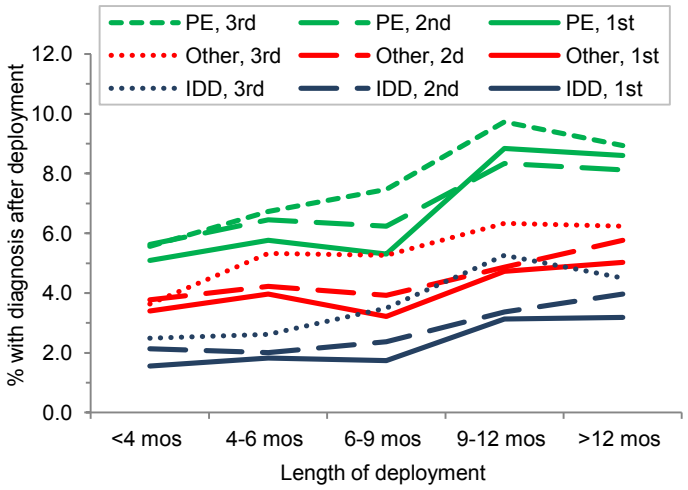
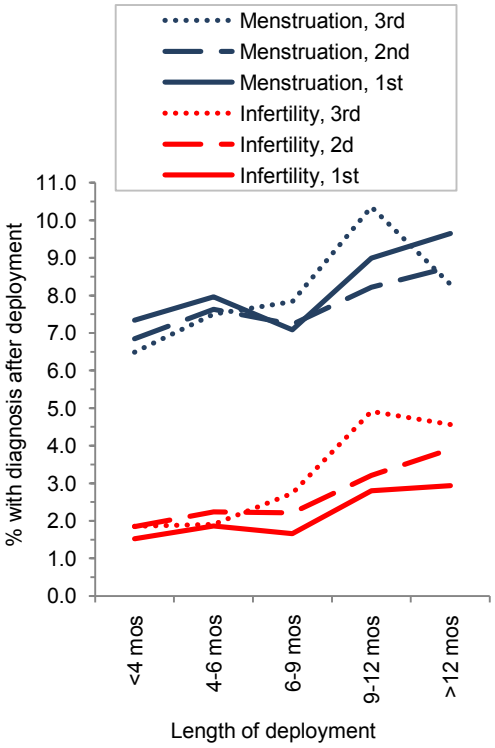


FIGURE 4. Percentages of female deployers diagnosed with "disorders of menstruation" or "infertility" after deployment, by the number and length of deployment, active component, U.S. Armed Forces



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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Acute Pelvic Inflammatory Disease, Active Component, U.S. Armed Forces, 2002-2011

Pelvic inflammatory disease (PID) refers to a group of inflammatory disorders of the female upper genital tract caused by the spread from the lower genital tract of *Chlamydia trachomatis* and other organisms. PID can cause chronic pelvic pain, fallopian tube damage, infertility and ectopic pregnancy. Between January 2002 and December 2011, 16,817 female service members met the surveillance case definition for acute PID. Incidence rates were stable at approximately 8 per 1,000 person-years overall and 11 per 1,000 person-years among known high-risk sub-populations (i.e., women 17-24 years old, in the Army, and of black, non-Hispanic race/ethnicity). Twenty-six women were diagnosed with PID within 10 days after medical evacuation from Iraq/Afghanistan. The proportion of servicewomen diagnosed with infertility subsequent to an incident diagnosis of acute PID increased during the period. Rates of PID are higher in the Army than the other Services. This may reflect differences in Service policies for chlamydia screening of new accessions.

Pelvic inflammatory disease (PID) refers to a group of inflammatory disorders of the female upper genital tract including endometritis, salpingitis and peritonitis. Most PID is caused by the spread from the lower genital tract of *Chlamydia trachomatis*, *Neisseria gonorrhoeae* and other organisms. There is no definitive confirmatory test for PID; its diagnosis is clinical, based on symptoms of pelvic or lower abdominal pain and examination findings of adnexal, uterine or cervical motion tenderness.[1,2] Most cases are treatable with oral antibiotics. Untreated or recurrent PID can cause chronic pelvic pain, fallopian tube damage, infertility and ectopic pregnancy.

PID is most common among women in their 20s of non-white race/ethnicity. Rates of hospitalizations and ambulatory visits for acute PID diagnoses have been declining in the U.S. since the mid 1980s.[3-5] However, rates of tubal infertility have not declined, leading researchers to implicate subclinical PID as a possible etiology of infertility.[6,7]

PID is militarily relevant due to the high prevalence of chlamydia infections among U.S. servicewomen.[8-10] Early testing and treatment for chlamydia infections have proven effective in reducing the risk of PID.[11] Publicly-funded chlamydia screening programs were implemented in the U.S. in the late 1980s.[2] In the late 1990s, the Navy began routine chlamydia screening, treatment and education for recruits at accession. While the Marine Corps and Air Force eventually followed suit, the Army opted for mandatory chlamydia testing within the first 12 months of service. Bloom and colleagues found that the Army's rates of PID are higher than the Navy's and hypothesized this was due, at least in part, to the Army's less rigorous chlamydia screening requirements.[12]

The International Classification of Diseases (ICD-9-CM) lists diagnostic codes for "acute," chronic" and "unspecified" PID. Acute and chronic PID are epidemiologically and clinically different; compared to acute PID, rates of chronic PID are much lower, and chronic PID is more often asymptomatic and bacteriologically sterile.[3]

This report applies a set of PID-defining ICD-9 codes proposed and validated by Satterwhite and colleagues to estimate the nature and incidence of both acute and unspecified pelvic inflammatory disease (hereafter, "acute PID") diagnosed during medical encounters of U.S. military members while on active duty.[5,13] This report also estimates the proportion of service members with acute PID who were diagnosed with infertility.

METHODS

The surveillance period was January 2002 through December 2011. The surveillance population included females aged 17-49 who served in an active component of the U.S. military during the surveillance period. Incident diagnoses of acute PID were identified from ICD-9-CM diagnostic codes recorded during hospitalizations and ambulatory visits of service members. The ICD-9 codes considered case-defining included acute infections of the upper genitourinary tract and inflammatory diseases of the pelvic organs and uterus **(Table 1)**.

An incident case of acute PID was defined as an individual with a case-defining PID diagnostic code during a medical encounter (hospitalization or ambulatory visit) as follows: a primary (first-listed) diagnosis of PID during a single medical encounter; a secondary (not first-listed) diagnosis of PID during a single medical encounter plus diagnoses with signs or symptoms consistent with acute PID in each diagnostic position antecedent to PID; or a PID diagnosis in any diagnostic position during two medical encounters that occurred between 1 and 60 days apart.

For surveillance purposes, PID diagnoses received during medical visits related to delivery and postpartum care (as indicated by an ICD-9-CM code between 640 and 679 with a fifth digit of 1, 2 or 4) were summarized separately and excluded from analyses. This enabled the exclusion of non-specific PID diagnostic codes used in cases of postpartum endometritis, a relatively common and clinically distinct disease entity.

Diagnoses of chlamydia or gonorrhea prior to incident PID diagnoses and

TABLE 1. Diagnostic codes (ICD-9-CM) considered indicative of acute pelvic inflammatory disease[5,13]

Acute gonococcal infections of the upper genitourinary tract	098.10, 098.16, 098.17
Gonococcal peritonitis	098.86
Chlamydia trachomatis infection of peritoneum	099.56
Acute or unspecified inflammatory disease of pelvic organs and tissues (salpingitis and oophritis, peritonitis, pelvic cellulitis)	614.0, 614.2, 614.3, 614.5, 614.8, 614.9
Acute or unspecified inflammatory diseases of uterus	615.0, 615.9

diagnoses of female infertility (ICD-9-CM: 628) prior to and following incident PID diagnoses, were also documented.

RESULTS

Between January 2002 and December 2011, 16,817 female service members met the surveillance case definition for acute PID after exclusion of 1,135 (6.3%) women whose acute PID was diagnosed during medical visits related to delivery/postpartum **(Table 2)**.

During the period, the overall incidence rate was 8.2 per 1,000 person-years (p-yrs) **(Table 2)**. Unadjusted rates were notably higher (approximately 11 per 1,000 p-yrs) among women who were in the Army, aged 17-24, and of black, non-Hispanic race/ethnicity. Relative to their respective subgroups, the lowest rates affected women older than 34 and of Asian or Pacific Islander race/ethnicity.

TABLE 2. Incidence rates (per 1,000 person-years) of acute/unspecified PID, active component, U.S. Armed Forces, 2002-2011

	No.	Incidence rate[a]	IRR[b]
Total	16,817	8.2	
Service			
Army	7,752	10.8	ref
Navy	3,579	7.0	0.65
Air Force	4,102	6.1	0.57
Marine Corps	1,072	9.2	0.85
Coast Guard	312	6.5	0.61
Age			
17-24	10,150	10.5	ref
25-34	4,995	6.8	0.65
35-49	1,672	4.7	0.45
Race/ethnicity			
Black, non-Hispanic	6,222	10.8	ref
White, non-Hispanic	7,077	6.9	0.64
Hispanic	1,943	8.4	0.77
Asian/Pacific Islander	506	5.5	0.51
American Indian	26	6.7	0.62
Other	1,043	7.6	0.70

[a]unadjusted
[b]Incidence Rate Ratio

The overall unadjusted rate of PID was 53 percent higher among soldiers than sailors. When the rates in each service branch were stratified by age, the Army had the highest rates of PID in each age group **(Figure 1)**. Same-aged women in the other service branches shared similar rates, with the exception of 17-24-year old Marines, whose rates were higher than their Navy and Air Force counterparts.

Incidence rates of PID among U.S. service members were stable during the period, ranging from 7.6 (in 2004 and 2006) to 9.0 (in 2010) **(Figure 2)**.

Approximately nine percent of incident cases were diagnosed during inpatient encounters and the remainder during ambulatory visits. During the 10-year period, 26 servicewomen received PID diagnoses within 10 days following medical evacuation from U.S. operations in Iraq or Afghanistan **(data not shown)**.

Nearly 70 percent of PID cases (n=11,761, 69.9%) had no recorded diagnoses of chlamydial or gonococcal infections prior their initial diagnosis of acute PID **(data not shown)**.

Approximately 1 in 7 (n=2,319; 13.8%) women with acute PID had at least one diagnosis of infertility during military service. Of these women, approximately half (n=1,134, 48.9%) received a diagnosis of infertility prior to their incident diagnosis of acute PID and the remainder (n= 1,185) had their first diagnosis of infertility following (or during the same visit as) their incident acute PID diagnosis **(data not shown)**.

The proportion of acute PID cases with a subsequent first-time infertility diagnosis increased sharply during the period from 2 percent (in 2002) to 11 percent in 2011 **(Figure 3)**.

EDITORIAL COMMENT

This report documents stable rates of acute PID among active component servicewomen during 2002-2011, at approximately 8 per 1,000 p-yrs overall and 11 per 1,000 p-yrs among known high-risk subpopulations (i.e., 17-24 years old, in the Army, black, non-Hispanic race/ethnicity). These rates and risk correlates are comparable to those previously reported in military and civilian populations.[3,12] The proportion

FIGURE 1. Incidence rates of pelvic inflammatory disease, by service branch and age group, active component females ages 17-49, U.S. Armed Forces, 2002-2011

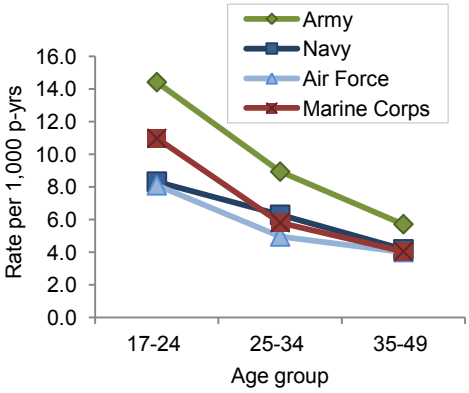


FIGURE 2. Incidence rates of pelvic inflammatory disease, active component females ages 17-49, U.S. Armed Forces, 2002-2011

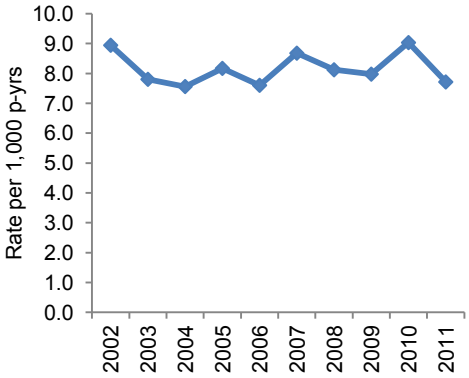
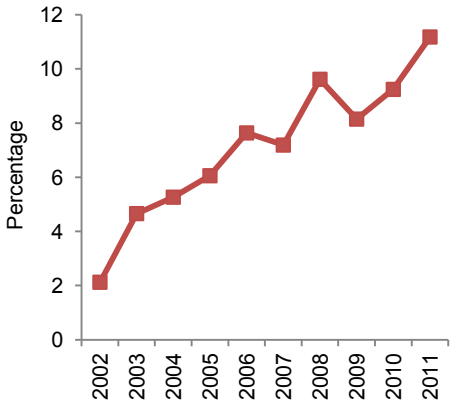


FIGURE 3. Among women with acute PID (n=16,817), proportion with an incident diagnosis of "female infertility" (ICD-9-CM:628) following or concurrently with their incident acute PID diagnosis, active component, U.S. Armed Forces, 2002-2011



of servicewomen diagnosed with infertility subsequent to an incident diagnosis of acute PID increased during the period for reasons which are unclear.

Rates of PID are higher in the Army than the other Services. This may reflect that most servicewomen receive chlamydia screening, treatment and education immediately upon accession, while women entering the Army may wait up to 12 months for such services. A report on a pilot chlamydia screening program for soldiers stationed in Korea found high chlamydia infection rates, prompting the suggestion that screening at accession (prior to assignment in Korea) may reduce disease transmission, prevent complications (e.g., PID) and cut costs.[9] Untreated chlamydia infections and their sequelae could pose serious risks to women who deploy or are assigned to installations remote from tertiary medical care.[14] The present report identified 26 women diagnosed with PID following medical evacuation from Iraq/Afghanistan.

Despite policies that require annual chlamydia screening of all female service members younger than 26, this report found that only 30 percent of PID cases had prior diagnoses of chlamydia or gonorrhea. Some PID patients may have had asymptomatic infections with those or other organisms, or other conditions implicated in PID, or sought treatment for their infections outside the military health system (MHS).

These results should be interpreted in consideration of several limitations. Women of black, non-Hispanic race/ethnicity (who in general have higher rates of acute PID than their counterparts) comprise a much larger proportion of women in the Army (approximately 38%) than in the other services (17-28%). The racial/ethnic composition of the Services, therefore, may account for some of the difference in PID rates among the Services. However, previous studies reported higher rates of PID among women in the Army than the Navy even after adjustment for race/ethnicity, age and marital status.[12] PID rate discrepancies among the service branches may also be affected by differences in case management and/or case ascertainment.

The proportion of women with acute PID who received diagnoses of infertility includes only those service members who received a diagnosis of infertility within the MHS; this excludes patients who sought treatment for infertility outside the MHS or after leaving the military. In published studies, 16-23 percent of PID patients failed to conceive during one year or longer following treatment.[15,16]

Finally, this analysis ascertained the number of women with incident (first-time) PID diagnoses, but did not attempt to describe the number of PID episodes among these women. Recurrent PID is common and individuals with recurrent PID experience higher rates of infertility and other sequelae than those without recurrence.[17] To estimate incidence rates, 588 women who were PID cases prior to the surveillance period were excluded from analysis; the proportion of PID cases with diagnoses of infertility may have been higher had these women been included.

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Ectopic Pregnancy, Active Component, U.S. Armed Forces, 2002-2011

Ectopic pregnancy (EP) is a rare adverse outcome in which a fertilized egg implants and develops outside of the uterus. Life-threatening cases of EP among deployed U.S. service members have been described. During 2002-2011, among active component females younger than 49, 1,245 EPs were diagnosed and treated as indicated by diagnostic and procedure codes recorded in electronic medical records. Annual numbers of EPs ranged from 91 to 151. During the period EP affected 0.64 percent of all pregnancies, with higher proportions among servicewomen in their 30s and of black, non-Hispanic race/ethnicity. As compared with civilians, service members had the same percentage of pregnancies that were ectopic but had lower proportions of EPs that were treated medically (with methotrexate) rather than surgically.

Ectopic pregnancy (EP) refers to the implantation and development of a fertilized egg outside of the uterus, most often in one of the fallopian tubes ("tubal pregnancy"). It is a rare but dangerous adverse pregnancy outcome; the products of conception may grow and eventually rupture the tube, causing severe hemorrhage. Death from EP is rare in developed countries, but life-threatening cases among U.S. servicewomen deployed to Iraq and Afghanistan have been described.[1,2]

Conditions that impede a fertilized ovum's movement from the ovary through the fallopian tubes to the uterus may place women at risk of EP.[3] Such conditions include scarring of the upper reproductive tract as a result of pelvic inflammatory disease, cesarean delivery, tubal and bowel surgery, or prior tubal pregnancy.[3] Half of all women diagnosed with EP have no known clinical risk factor.[4] In the United States, EPs affect higher percentages of pregnancies among women older than 35 and of non-white race/ethnicity.

Proportions of EP in the U.S. increased sharply during the 1970s and 80s, peaked in 1992 at between 1 and 2 percent of pregnancies, and have since remained stable.[5-7] The observed increase was partially attributed to an improved ability to detect early EPs that resolved without intervention (i.e., due to tubal abortion or spontaneous reabsorption).[8]

EP can be treated surgically, usually with laparoscopy or laparotomy, or medically with methotrexate injection. Expectant management with close monitoring is an option in some cases.[9] Although surgical removal of EP is the most common treatment, more conservative management has been advocated to reduce damage to reproductive organs, thereby preserving future fertility.[10, 11]

This report estimates numbers and proportions of ectopic pregnancy among U.S. military members using methods described by Hoover and colleagues, who summarized 11,989 EPs in a nationally representative group of insured women.[7]

METHODS

The surveillance period was January 2002 to December 2011. The surveillance population included females aged 18 to 48 years who served in an active component of the U.S. military at any time during the surveillance period.

Ectopic pregnancies were identified by diagnostic and procedure codes recorded during inpatient and outpatient encounters of service members in military and non-military (outsourced care) medical facilities. The administrative case definitions were adapted from those described by Hoover and colleagues, who assumed that a diagnosed EP would be treated. A case of EP was defined as an individual with both a diagnostic code for EP and a procedural code indicating treatment **(Table 1)**. This analysis required that the diagnostic and procedure codes be recorded during the same encounter and allowed only one EP per individual per 180 days. The number

TABLE 1. Diagnostic and procedural codes used to define ectopic pregnancy

Diagnostic codes (ICD-9-CM)	
633.x, 761.4	Ectopic pregnancy
Inpatient procedure codes (ICD-9-CM)	
6501, 6509, 6531	Oophorotomy, oophorectomy
6541, 6549	Salpingo-oophorectomy
6601, 6602	Salpingotomy,salpingostomy
6651, 6662, 6669	Salpingectomy
6952	Aspiration, curettage
7430	Ectopic pregnancy removal
9925	Methotrexate injection
Outpatient procedural codes (CPT)	
49320	Diagnostic laparoscopy
58661, 58700, 59120, 59151	Oophorectomy and/or salpingectomy
58673, 58770	Salpingostomy (salpingoneostomy)
58679	Laparoscopy, oviduct, ovary
58720	Salpingo-oophorectomy
59121, 59130, 59135, 59136, 59140, 59150	Other surgical or laproscopic treatment of ectopic pregnancy
90782, 96401, J9250, J9260	Methotrexate injection

of individuals who received diagnoses of EP with or without a procedure code ("suspected EP") was also evaluated.

The proportion of all pregnancies that were ectopic was calculated as the number of treated ectopic pregnancies divided by total number of pregnancies expressed as a percent. Total pregnancies were estimated using ICD-9-CM diagnostic codes for deliveries, miscarriages, abortions and ectopic pregnancies documented during medical encounters of all women in the surveillance population. For the purpose of counting total pregnancies, a birth was allowed every 280 days and other types of pregnancies every 30 days.

RESULTS

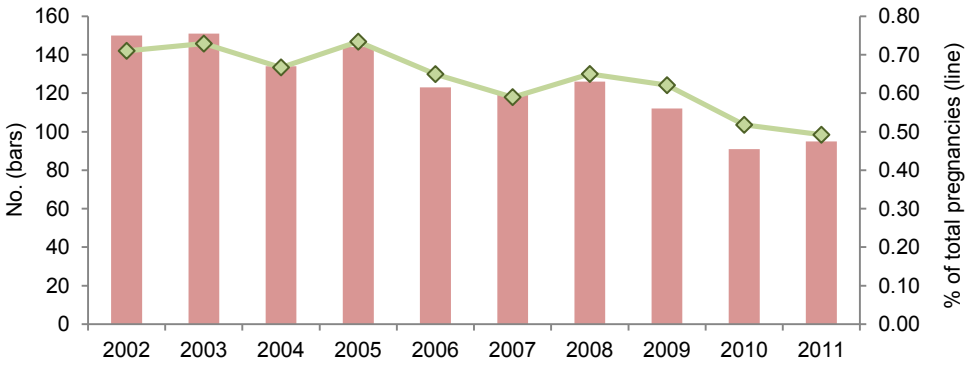
From January 2002 to December 2011, among active component females younger than 49, there were 1,245 cases of treated EP affecting 1,216 individuals (29 women had more than one EP). These EPs comprised 0.64 percent of total pregnancies (n=194,956) during the period **(Table 2)**. Annual numbers of EP ranged from 91 (in 2010) to 151 (in 2003). Proportions were stable at approximately 0.70 percent of pregnancies during 2002 to 2005 and then declined through 2011 to 0.49 percent **(Figure 1)**.

TABLE 2. Percent of all pregnancies diagnosed as ectopic, active component, U.S. Armed Forces, 2002-2011

	No.	%[a]	RR[b]
Total	1,245	0.64	.
Age group			
< 20	50	0.53	ref
20-24	450	0.50	0.94
25-29	375	0.69	1.30
30-34	247	0.93	1.76
35-39	104	0.90	1.70
40 +	19	0.75	1.41
Race/ethnicity			
White, non-Hispanic	497	0.54	ref
Black, non-Hispanic	485	0.85	1.57
Hispanic	155	0.62	1.13
Asian/Pacific Islander	29	0.35	0.63
American Indian	1	0.23	0.42
Other	78	0.60	1.10
Service			
Army	505	0.71	ref
Navy	340	0.68	0.96
Air Force	316	0.55	0.78
Marine Corps	73	0.54	0.77
Coast Guard	11	0.32	0.45

[a]% of all pregnancies
[b]Ratio to referent (ref)

FIGURE 1. Number and proportion of ectopic pregnancies, active component females <49 years of age, U.S. Armed Forces, 2002-2011



Women with treated EPs comprised 22 percent of all individuals whose records contained diagnoses of EP with or without treatment. Of suspected EPs (n=5,547), two-thirds of hospitalized cases (799/1,198, 67%), but only one-tenth of outpatient cases (446/4,349, 10%) were treated **(data not shown)**.

Proportions of total pregnancies that were ectopic were highest among servicewomen in their 30s (0.91%), of senior enlisted rank (0.85%) and of black, non-Hispanic race/ethnicity (0.85%). EP proportions were higher in the Army and Navy than the other service branches **(Table 2)**. Approximately 11 percent of cases had had a diagnosis of pelvic inflammatory disease sometime prior to their EP; an additional 11 percent had prior diagnoses of *Chlamydia trachomatis* or *Neisseria gonorrhoeae* infections of the reproductive tract **(data not shown)**.

The proportions of EPs initially treated surgically or medically with methotrexate were 82 and 18 percent, respectively. Annual proportions of surgical versus medical treatment were stable during the 10-year period.

EDITORIAL COMMENT

EP is a relatively rare event, affecting an average of 125 servicewomen per year. Only 0.64 percent of pregnancies among active component military members were ectopic. This is the exact same proportion reported among civilians during 2002 to 2007 by Hoover and colleagues. Proportions of diagnosed EP have not been increasing among civilians or military members in recent years.

More than one-fifth of EP cases were preceded by either diagnoses of genital infections with chlamydia or gonococci or pelvic inflammatory disease. PID is the one of the strongest independent risk factors for EP, and European studies suggest that preventing PID may reduce EP on a population level. [3,4,12-14]

Only about 18 percent of ectopic pregnancies among U.S. service members appear to have been treated medically with methotrexate, and this proportion has not changed in at least 10 years. In contrast, the proportions of medically managed EPs among civilians have been increasing. Hoover reported that medically treated EPs as a percentage of all treated EPs increased from 11 to 35 percent during the period 2002 to 2007. In a study of managed care patients in California, medical management increased from 30 percent in 1997 to 39 percent in 2000.[6] The relatively low proportion of medically treated EPs in the U.S. military may represent an opportunity for achieving future cost savings and improved fertility outcomes following EP.

This analysis of treated EP relied on a highly specific surveillance case definition and should be considered an underestimate of the true incidence of EP among U.S. service members. Only 22 percent of active

component members with a recorded diagnosis of EP also had documentation of treatment; the remaining "suspected" EPs were presumably provisional or "rule-out" diagnoses, though some may have been EPs that were expectantly managed. The proportion of EPs that are expectantly managed in the U.S. is not known. The total number of pregnancies among servicewomen was also underestimated since elective abortions are not provided within the military health system (MHS) and abortions obtained at service members' own expense are not documented in records of MHS encounters.

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Iron Deficiency Anemia, Active Component, U.S. Armed Forces, 2002-2011

Iron deficiency anemia (IDA) is the most common cause of anemia in the United States, and it particularly affects women of child-bearing age and black, non-Hispanic race/ethnicity. During the surveillance period there were 10,157 incident ("new") cases of IDA among active component service members; the overall incidence rate was 7.1 per 10,000 person-years. The annual incidence rates increased in both males and females during the period. Rates of IDA were higher among service members who were female, in the youngest (<20 years) and oldest age groups (40+ years), and of black, non-Hispanic race/ethnicity. Most (85.3%) incident cases had no additional encounters for IDA one year or more after their incident encounter. The most common diagnoses associated with IDA during the one year before or after the incidence dates of IDA were "gastrointestinal hemorrhage" (12.4%) in males and "disorders of menstruation and other abnormal bleeding from the female genital tract" (15.2%) in females. Because IDA can adversely affect physical work capacity and cognitive functioning, health care providers should be alert to IDA among service members, particularly servicewomen, before intensive training activities and deployment.

Iron deficiency (ID) is the most common micronutrient deficiency, affecting up to 2 billion people worldwide.[1] Iron deficiency may range from mild depletion of the body's iron stores to a substantial iron deficit resulting in iron deficiency anemia (IDA). Iron is an essential part of hemoglobin, the substance in red blood cells (RBCs) that carries oxygen from the lungs to the rest of the body. In the face of serious iron deficiency, the bone marrow produces fewer RBCs than normal (anemia), and the RBCs contain less hemoglobin than usual. The net effect is impairment of oxygen transport to cells throughout the body. An individual with IDA may have no symptoms or mild symptoms that worsen as IDA progresses. Common symptoms include fatigue, weakness, cold hands and feet, shortness of breath, headache, dizziness, irritability, and glossitis.[2] In general, treatment of IDA is directed at the underlying cause of the disease but also typically includes the use of iron supplementation and dietary changes to increase iron intake and absorption.

IDA is the leading cause of anemia in the United States and is most common among women of child-bearing age and black, non-Hispanic race/ethnicity.[3,4] In premenopausal women, menstrual blood loss, particularly in women with heavy, long, or frequent menstrual periods, and pregnancy-related iron loss account for most IDA diagnoses.[2,3] Occult bleeding from the gastrointestinal tract (e.g., from ulcers, infections, or cancers of the digestive system) is the leading cause of IDA in men and postmenopausal women.[5] Other possible factors in IDA include blood loss from acute trauma or chronic conditions such as uterine leiomyomas, as well as inadequate body iron stores due to an iron poor diet or impaired absorption of ingested iron.

Among members of the U.S. Armed Forces, IDA is more often found in women although both young men and women engaged in strenuous physical activity (e.g., during basic training or operational deployments) are at risk for depletion of iron stores.[6,7] Maintaining optimal iron status among military personnel is important as IDA can have health and military readiness implications. If not detected and treated, IDA can cause reduced physical work capacity, poor cognitive functioning, and inadequate immune response.[8-10] As such, the condition may impact situations that require maximal cognitive and physical performance such as training and combat operations.[11]

This report summarizes the numbers, rates, and trends of incident ("new"), recurrent, and chronic cases of IDA and associated conditions among active component servicemen and women.

METHODS

The surveillance period was 1 January 2002 to 31 December 2011. The surveillance population included all U.S. service members of the Army, Navy, Air Force, Marine Corps, and Coast Guard who served in the active component during the surveillance period. Cases were identified from standardized records of all hospitalizations and outpatient medical encounters during the surveillance period in fixed (e.g., not deployed, at sea) military and nonmilitary (purchased care) medical facilities.

For this analysis, a case was defined by a diagnosis with an International Classification of Diseases, Clinical Modification (ICD-9-CM) code of 280.x "iron deficiency anemia" in the first or second diagnostic position on a record of: 1) one inpatient encounter; 2) two outpatient encounters within 365 days of each other; or 3) two outpatient encounters, one with a diagnosis of ICD-9-CM: 281.9 or 285.9 ("unspecified deficiency anemia" or "anemia, unspecified") followed by an encounter with a specific iron deficiency anemia diagnosis within 365 days. Individuals with pregnancy-related anemia (ICD-9-CM: 648.2x) were excluded from the analysis if their history included this diagnosis within the preceding two years.

Each affected service member could be considered an incident ("new") case only once during the surveillance period. The incidence date was considered to be the date of the first medical encounter that included a diagnosis of anemia. Incident

cases were then stratified into three mutually exclusive categories: 1) a "one time" case if an individual met the criteria for an incident IDA case but had no subsequent encounters for IDA during the remainder of the surveillance period; 2) a "recurrent case" if an incident case had just one additional IDA encounter 365 days or more after the incidence date; or 3) a "chronic case" if there were two or more additional encounters 365 days or more after the incidence date and those encounters were separated by 365 days or more. An individual was counted as either a "one time," "recurrent," or "chronic" case once during the surveillance period.

The medical records of anemia cases were queried to identify "associated conditions" **(Table 1)** which may have contributed to the development of the anemia. Associated conditions were defined as those occurring within 365 days before or after the incident diagnosis of IDA. Each such associated diagnosis was defined by an ICD-9-CM code of interest recorded in either of the first two diagnostic positions during a single inpatient encounter or during two outpatient encounters separated by fewer than 365 days.

RESULTS

Incident ("new") cases

During 2002 to 2011, there were 10,157 incident cases ("new cases") of iron deficiency anemia among active component service members. The incidence rate was 7.1 per 10,000 person-years (p-yrs) **(Table 2)**.

A majority of incident cases occurred in females (60%; n=6,052); the overall incidence rate was 7.8 times higher in females (29.5 per 10,000 p-yrs) than among males

TABLE 1. Conditions possibly associated with iron deficiency anemia

Infectious Diseases	
126.x	Ancylostomiasis/necatoriasis
Neoplasms	
150.x-154.x	Malignant neoplasm of selected digestive organs
174.x-175.x	Malignant neoplasm of breast (female and male)
218.x	Uterine leiomyoma
Diseases of the blood/blood-forming organs	
281-289	All diseases of blood except 280 (iron deficiency anemia)
Diseases of the circulatory system	
455.x	Hemorrhoids
Diseases of the digestive system	
530.x	Diseases of the esophagus
531.x-534.x	Ulcer of the digestive tract
535.x-558.x	Gastritis and colitis
562.x	Diverticula of intestine
578.x	Gastrointestinal hemorrhage
Diseases of the genitourinary system	
585.x	Chronic kidney disease
626.x	Disorders of menstruation/ other abnormal bleeding
627.0	Premenopausal menorrhagia
627.1	Postmenopausal bleeding
Symptoms, signs, and ill-defined conditions	
780.2	Syncope and collapse
780.4	Dizziness and giddiness
780.79	Other malaise and fatigue
Injury and poisoning	
800.x-829.x	Fractures
860.x-869.x	Internal injury of the thorax, abdomen, and pelivs
870.x-897.x	Open wounds
900.x-904.x	Injury to blood vessels
940.x-949.x	Burns
958.x-959.x	Tramatic complications/ unspecified injuries

TABLE 2. Number and rates of iron deficiency anemia by case type, active component, U.S. Armed Forces, 2002-2011

	Incident cases[a]			One time cases[b]			Recurrent cases[c]			Chronic cases[d]		
	No	Rate[e]	IRR	No	Rate[e]	%[f]	No	Rate[e]	%[f]	No	Rate[e]	%[f]
Total	10,157	7.1	.	8,668	6.7	85.3	623	0.5	6.1	866	0.7	8.5
Sex												
Female	6,052	29.5	8.8	4,962	26.6	82.0	449	2.4	7.4	641	3.4	10.6
Male	4,105	3.4	ref	3,706	3.4	90.3	174	0.2	4.2	225	0.2	5.5
Age group												
< 20	2,258	11.8	2.6	2,041	12.1	90.4	32	0.2	1.4	53	0.3	2.3
20-29	3,180	4.5	ref	2,767	4.3	87.0	215	0.3	6.8	254	0.4	8.0
30-39	2,613	6.8	1.5	2,070	6.0	79.2	182	0.5	7.0	315	0.9	12.1
40+	2,106	13.9	3.1	1,790	13.1	85.0	194	1.4	9.2	244	1.8	11.6
Female age group												
< 20	1,636	53.0	3.1	1,455	53.8	88.9	26	1.0	1.6	41	1.5	2.5
20-29	1,830	16.9	ref	1,535	15.6	83.9	160	1.6	8.7	192	2.0	10.5
30-39	1,514	31.2	1.8	1,120	25.3	74.0	133	3.0	8.8	229	5.2	15.1
40+	1,072	59.3	3.5	852	50.5	79.5	130	7.7	12.1	179	10.6	16.7
Male age group												
< 20	622	3.9	1.7	586	4.1	94.2	6	0.0	1.0	12	0.1	1.9
20-29	1,350	2.3	ref	1,232	2.3	91.3	55	0.1	4.1	62	0.1	4.6
30-39	1,099	3.3	1.5	950	3.2	86.4	49	0.2	4.5	86	0.3	7.8
40+	1,034	7.8	3.4	938	7.8	90.7	64	0.5	6.2	65	0.5	6.3
Race/ethnicity												
White, non-Hispanic	4,029	4.5	ref	3,588	4.4	89.1	196	0.2	4.9	245	0.3	6.1
Black, non-Hispanic	4,273	17.7	4.0	3,470	16.1	81.2	314	1.5	7.3	489	2.3	11.4
Hispanic	879	5.9	1.3	773	5.7	87.9	49	0.4	5.6	57	0.4	6.5
Asian/Pacific Islander	341	6.0	1.4	295	5.8	86.5	26	0.5	7.6	20	0.4	5.9
Other	635	8.0	1.8	542	7.6	85.4	38	0.5	6.0	55	0.8	8.7
Service												
Army	3,982	7.8	2.5	3,384	7.2	85.0	250	0.5	6.3	350	0.7	8.8
Navy	2,453	7.1	2.3	2,147	7.0	87.5	119	0.4	4.9	186	0.6	7.6
Air Force	2,826	8.2	2.7	2,339	7.6	82.8	217	0.7	7.7	269	0.9	9.5
Marine Corps	575	3.1	ref	522	3.1	90.8	16	0.1	2.8	37	0.2	6.4
Coast Guard	321	8.0	2.6	276	7.6	86.0	21	0.6	6.5	24	0.7	7.5

[a]A service members was an incident ("new") case once per surveillance period
[b]One time case: no follow-up encounters 365 days or more after their incident encounter
[c]Recurrent case: one follow-up encounter 365 days or more after their incident encounter
[d]Chronic case: two or more follow-up encounters 365 days or more after their incident encounter
[e]Rate per 10,000 p-yrs
[f]Percentage of incident cases

(3.4 per 10,000 p-yrs). Females in the youngest (<20 years) and oldest (≥40 years) age groups and males in the oldest age group had the highest rates of IDA compared to their respective gender and age groups. Black, non-Hispanic service members had a rate that was almost 4 times that of white, non-Hispanic counterparts. Among the services, the overall incidence rate was lowest in the Marine Corps (3.1 per 10,000 p-yrs); rates among the remaining services (range 7.1 to 8.2 per 10,000 p-yrs) were similar **(Table 2)**.

Among females, the incidence rates increased from 19.4 per 10,000 p-yrs in 2002 (n=409) to 37.2 per 10,000 p-yrs in 2010 (n=749) and then decreased to 30.4 per 10,000 p-yrs in 2011 (n=631) **(Figure 1a)**. Among males, the rates increased from 2.3 per 10,000 p-yrs in 2002 (n=275) to 4.4 per 10,000 p-yrs in 2009 (n=551), then decreased to 3.7 and 3.6 per 10,000 p-yrs in 2010 and 2011, respectively **(Figure 1b)**.

When stratified by age group, gender, and race/ethnicity, incidence rates were highest among female, black, non-Hispanic service members in the youngest and oldest age groups (102.5 and 109.5 per 10,000 p-yrs, respectively) **(Figure 2a)**. Among males, black, non-Hispanic service members in the oldest age group had the highest incidence rate (15.0 per 10,000 p-yrs) **(Figure 2b)**.

One time cases

Of all incident cases, 85.3 percent (n=8,668) were one time cases, i.e., had no follow-up encounters for IDA after the case-defining year of diagnosis **(Table 2)**. Compared to females, a greater proportion of incident male IDA cases were one time cases (males: 90%, n=3,706; females: 82%, n=4,962).

Recurrent/chronic cases

Of all incident cases, 6.1 percent (n=623) were considered recurrent cases, i.e., had one IDA-related encounter 365 days or more after the first incident case encounter; 8.5 percent (n=866) were considered chronic cases, i.e., had two or more IDA-related encounters 365 days or more after the incident case encounter **(Table 2)**. Recurrent/chronic cases had demographic characteristics similar to incident cases. Among all incident cases, greater proportions of females were considered to have become recurrent (7.4% [n=449]) and chronic (10.6% [n=641]) cases compared to males (4.2% [n=174] and 5.5% [n=225], respectively).

In both females and males, recurrent/chronic rates and proportions of incident cases increased with age **(Table 2)**. Rates of recurrent/chronic IDA were highest in black, non-Hispanic females (1.5 and 2.3 per 10,000 p-yrs, respectively) compared to other race/ethnicities. When stratified by age group, gender, and race/ethnicity, recurrent/chronic rates were highest among the oldest (>40 years), black, non-Hispanic females (11.5 and 11.5 per 10,000 p-yrs, respectively) **(data not shown)**.

Associated conditions

Of the incident cases identified during the period, more than half (55%; n=5,632) were diagnosed with a condition associated with IDA within either the one year before or the one year after the dates of the incident diagnoses of IDA. By gender, a greater proportion of males (65%) than females (49%) had an associated condition **(data not shown)**. Among males, 40 percent of incident cases (n=1,637) had associated "diseases of the digestive system" **(data not shown)**. Within this category, the subcategory contributing the greatest proportion of cases with an associated condition was "gastrointestinal hemorrhage" (12.4%; n=510). It is worth noting that 1.5 percent (n=63) of all males diagnosed with IDA (n=4,105) during the surveillance period were diagnosed with malignancies of the colon and/or rectal regions within a year of

FIGURE 1a. Incident cases and incidence rate of iron deficiency anemia, active component females, U.S. Armed Forces, 2002-2011

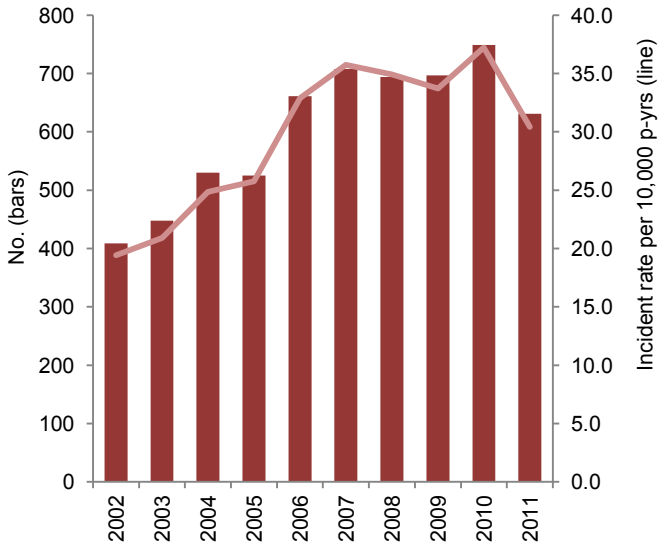


FIGURE 1b. Incident cases and incidence rate of iron deficiency anemia, active component males, U.S. Armed Forces, 2002-2011

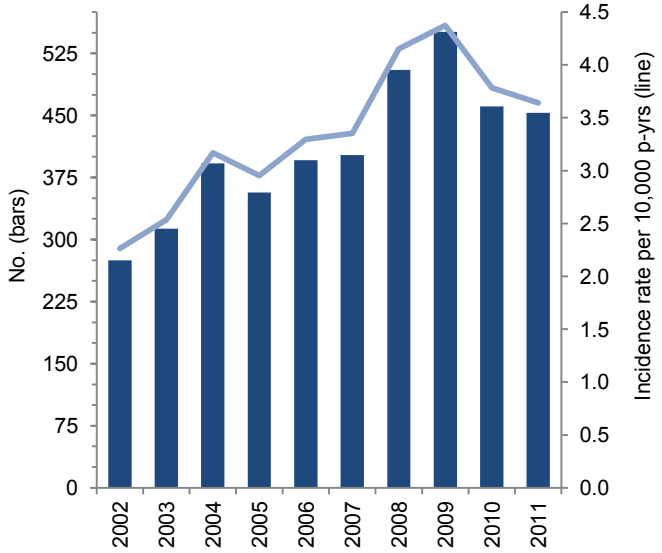


FIGURE 2a. Incidence rates of iron deficiency anemia by age group and race/ethnicity, active component females, U.S. Armed Forces, 2002-2011

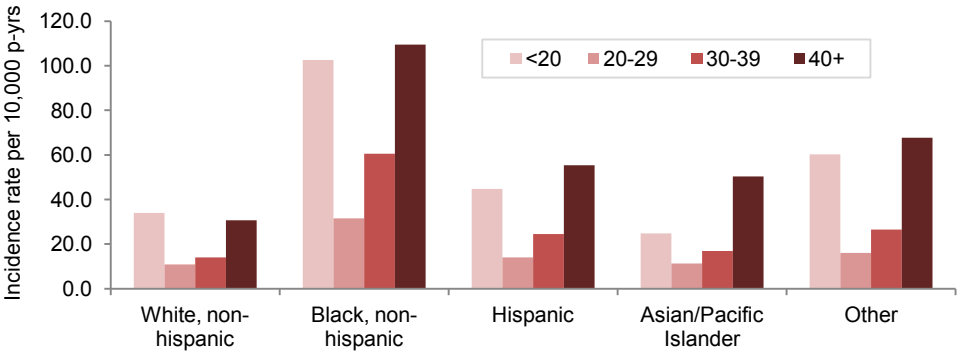
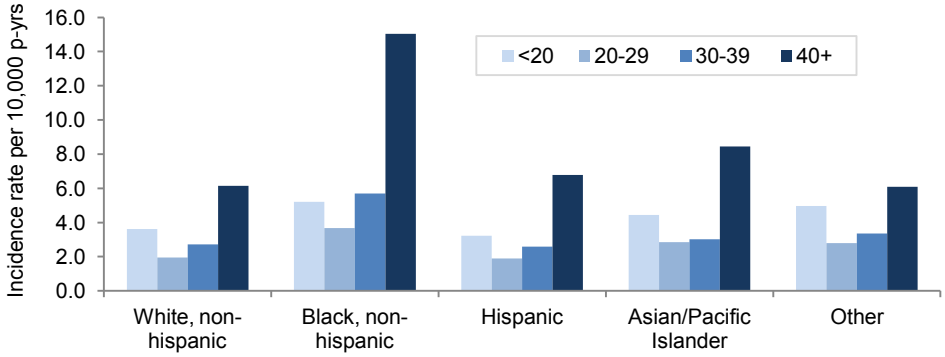


FIGURE 2b. Incidence rates of iron deficiency anemia by age group and race/ethnicity, active component males, U.S. Armed Forces, 2002-2011



their incident IDA diagnosis. Most (73%; n=46) of those malignancies were diagnosed during the year after the IDA incidence date.

Among females, the most often reported associated diagnoses were in three main categories: "diseases of the genitourinary system" (15.6%; n=943), "diseases of the digestive system" (15.4%; n=935), and "neoplasms" (8.9%; n=540). Within these categories, the subcategories contributing the greatest proportion of cases with an associated condition were "disorders of menstruation and other abnormal bleeding from the female genital tract" (15.2%; n=922); "other and unspecified noninfectious gastroenteritis and colitis" (8.0%, n=483); and "uterine leiomyoma" (8.5%; n=516), respectively **(data not shown)**. Only 0.1 percent (n=8) of all women diagnosed with IDA were found to have colorectal cancer; most of them (n=6) were diagnosed after their IDA incidence date.

Associated diagnoses of serious injuries were documented for only 4.5 percent and 1.8 percent of all men and women with IDA diagnoses. Among the males, half of those injuries were recorded in the year after IDA was diagnosed. Among females, 59 percent were after the IDA diagnosis.

When examining recurrent/chronic cases 69 percent of males and 41 percent of females had an associated condition diagnosed within the one year before or after the incident diagnosis of IDA. Similar to all incident cases among males, "diseases of the digestive system" remained the category associated with the most recurrent and chronic IDA cases in men; however, in addition to "gastrointestinal hemorrhage (12.5%; n=50), the other subcategories contributing the greatest proportion of cases with an associated condition were "diseases of the esophagus" (12.8%; n=51), and "gastritis and duodenitis" (12.0%; n=48) **(data not shown)**.

Among females, the distributions of and proportions affected by associated conditions were similar between incident and recurrent/chronic conditions, i.e., "uterine leiomyoma," "noninfectious gastroenteritis and colitis," and "disorders of menstruation."

EDITORIAL COMMENT

This report documents that, among U.S. service members, less than 1 in 1,000 males but 3 in 1,000 females were diagnosed with IDA during the surveillance period. Active component service members are similar to the U.S. civilian population in that rates of IDA are highest among black, non-Hispanic females. This finding is consistent with national studies and with research indicating lower mean hemoglobin concentrations in black, non-Hispanics compared to white, non-Hispanic counterparts even after adjustment for iron status.[1,2] A previous *MSMR* study documented that black, non-Hispanic women in the Armed Forces had much higher incidence rates of uterine leiomyomas, a diagnosis that affected 8.5 percent of women with IDA in this study.[14]

Of note, these data suggest that the rates of incident ("new") IDA cases have been increasing among active component service members since 2002. Over the period of study, ongoing conflicts in Iraq and Afghanistan and the resultant increase in demanding physical training and repeated deployments may be associated with decrements in iron status among some military personnel. This study found, however, that traumatic injuries were infrequently associated with IDA, suggesting that severe blood loss and prolonged healing from possible combat wounds were not major contributors to the increase in rates of IDA. Previous studies of military recruits indicated that female personnel experience decreased iron status and diminished work capacity following training operations.[9,15] Increased training may also lead to lower body weight and changes in menstrual blood flow, both which have been associated with IDA.[16,17]

The increase in rates of IDA might also be attributable to dietary changes that led to inadequate daily intake of iron (recommended at 8mg/18mg/day for male and females, respectively, aged 19-50 years). Nutritional data collected during field training and in garrison demonstrate suboptimal iron intake among female soldiers; therefore, women who are deployed may be significantly affected if inadequate iron intake occurs routinely or for extended periods.[18] Insufficient iron intake may be further compounded by the intense physical training and immune challenges common to field training and operational deployment.[6]

Furthermore, dietary habits (e.g., avoidance of red meat, vegetarianism) may fail to deliver sufficient amounts of iron to replace losses. High levels of consumption of coffee and tea and the excessive use of medications to inhibit stomach acid secretion may interfere with iron absorption.[19,20]

While studies examining IDA in military personnel are limited, these findings are consistent with a recent study of iron status, ID and IDA prevalence among military personnel deployed to Afghanistan that found ID in 1 percent and 6 percent and IDA in 0 percent and 2 percent of males and females, respectively.[11] This report shows that 18 percent of females and 10 percent of males diagnosed with IDA experience a recurrence (i.e., recurrent or chronic) of their condition. Given that menstrual blood loss is a strong determinant of iron status and that many women are unable to consume adequate iron to prevent this deficit, it is not surprising that, in susceptible individuals, the condition returns.[17]

In conclusion, for women in the military, reducing the incidence and prevalence of IDA is deserving of continued attention. The findings of this report - along with those of others described here - suggest that health care providers should be alert to the possibility of IDA among servicewomen before intensive training activities and operational deployment and particularly for those with a history of IDA.[9,11] Furthermore, female service members should be made aware of the signs and symptoms of poor iron status and encouraged to optimize their dietary intake of iron, particularly during times of intense physical training or deployment.

Acknowledgement: Susan Allen Ford, PA-C, MPH, Armed Forces Health Surveillance Center

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Historical Snapshot: Dr. Mary E. Walker, Civil War Surgeon, Medal of Honor Recipient

Since the Revolutionary War, when General George Washington recognized the need to hire nurses to care for wounded soldiers, women have served in multiple roles to meet the healthcare needs of American service members in wartime.[1] The role of women today is substantial, comprising about 40 percent of officers and nearly one-third of enlisted service members in the healthcare field.[2] However, as the biography of Dr. Mary Walker attests, women have historically faced significant barriers in the pursuit of careers in military medicine.

Born in 1832 in Oswego County, New York, Mary Walker, along with her four sisters and one brother, was always encouraged to pursue higher education. Walker initially attended and graduated from Falley Seminary in New York and worked briefly as a teacher. In December 1853, at the age of 21, she enrolled in Syracuse Medical College and after three 13-week semesters graduated as Dr. Mary Walker. She was the second woman to graduate from medical school in the United States; Elizabeth Blackwell had graduated from Geneva Medical College four years earlier. Together with her husband, a fellow physician, Walker established a medical practice in Rome, New York. The practice, however, was unsuccessful.[3]

At the outbreak of the Civil War in 1861, Dr. Walker applied for a commission as a surgeon in the U.S. Army. Rejected but undeterred, she volunteered as a nurse in Washington's Patent Office Hospital and also cared for the wounded at the Battle of Bull Run. The following year, still in a volunteer capacity, she served as a field surgeon and treated casualties at the Battles of Warrenton and Fredericksburg in Virginia. In 1863, after caring for casualties at the Battle of Chickamauga, Walker again requested a commission as an Army doctor. She achieved partial success when Major General George H. Thomas appointed her an assistant surgeon with the 52nd Ohio Infantry, making her the first woman doctor to serve with the Army Medical Corps. Captured by Confederate troops on April 10, 1864, she was confined for four months before her release in a prisoner of war exchange on August 12, 1864. Although she requested a return to battlefield medicine upon her release, she was assigned instead to a female prison hospital in Kentucky as the "surgeon-in-charge" and later ran an orphanage in Tennessee.[3]

In her postbellum career, Walker – a non-conformist who favored wearing modified men's clothing – advocated on behalf of many causes, among them women's rights and suffrage, dress reform, and temperance. Her wartime service was recognized formally by Major Generals William T. Sherman and George H. Thomas, who nominated Walker for the Medal of Honor. When she received the award on January 24, 1866, she became, and still remains, its only female recipient. In 1917, upon review of the terms of eligibility, Walker and 910 other honorees had their medals rescinded. Refusing to return the medal, Walker wore it until her death in 1919. Fifty-eight years later, President Jimmy Carter posthumously reinstated Walker as a Medal of Honor recipient.[4]

Dr. Walker is commemorated in the names of the Whitman-Walker Clinic in Washington, DC and the Dr. Mary E. Walker Center for outpatient services at the National Training Center, Ft. Irwin, CA.

Medal of Honor Citation:

Whereas it appears from official reports that Dr. Mary E. Walker, a graduate of medicine, "has rendered valuable service to the Government, and her efforts have been earnest and untiring in a variety of ways," and that she was assigned to duty and served as an assistant surgeon in charge of female prisoners at Louisville, Ky., upon the recommendation of Major-Generals Sherman and Thomas, and faithfully served as contract surgeon in the service of the United States, and has devoted herself with much patriotic zeal to the sick and wounded soliders, both in the field and hospitals, to the detriment of her own health, and has also endured hardships as a prisoner of war four months in a Southern prison while acting as contract surgeon; and

Whereas by reason of her not being a commissioned officer in the military service, a brevet or honorary rank cannot, under existing laws, be conferred upon her; and

Whereas in the opinion of the President an honorable recognition of her services and sufferings should be made: It is ordered, That a testimonial thereof shall be hereby made and given to the said Dr. Mary E. Walker, and that the usual medal of honor for meritorious services be given her.

Given under my hand in the city of Washington, D.C., this 11th day of November, A.D. 1865.

Andrew Johnson,
President

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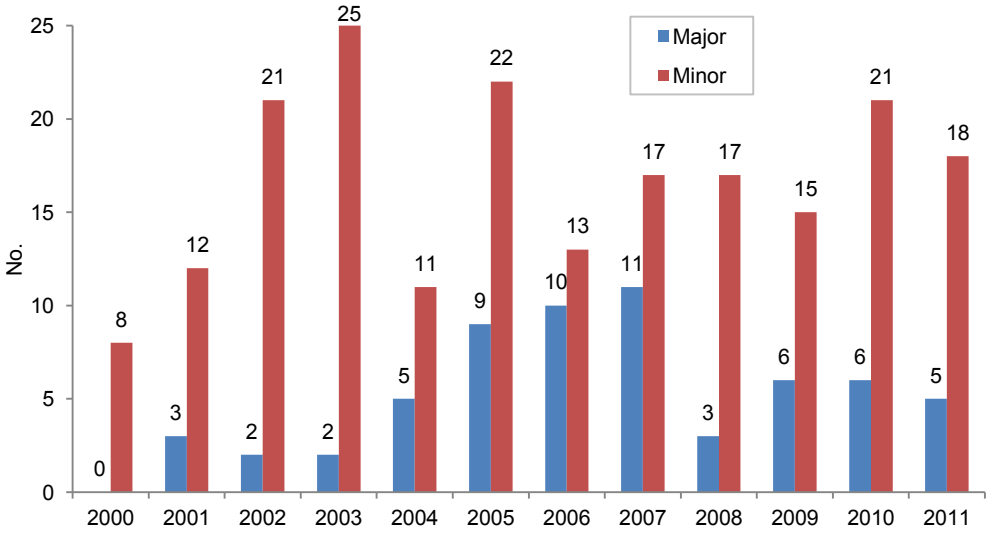
Surveillance Snapshot: Traumatic Amputations among Female Service Members, Active and Reserve Components, U.S. Armed Forces, 2000-2011

Number of minor[a] and major[b] extremity amputations, active and reserve components, U.S. Armed Forces, 2000-2011



[a]Minor amputation: fingers, toes, unspecified
[b]Major amputation: hands, arms, feet, legs

Service members are at risk for traumatic amputations during combat deployments and in many other settings (e.g., motor vehicle accidents). Due to the expanding role of women in combat operations in Iraq and Afghanistan, an increasing number of servicewomen have been exposed to severe injury risk during deployment. A previous *MSMR* report described traumatic amputations of the extremities among all service members; this snapshot uses the same methodology but is restricted to servicewomen alone.[1]

During the 12-year surveillance period there were 262 amputations among 260 servicewomen. A majority of the amputations (76%; n=200) were considered minor amputations. Of the 62 major amputations affecting 60 women, 52 were lower extremity amputations and 10 were upper extremity amputations **(data not shown)**. During the surveillance period the number of major amputations increased from 2003 to 2007, decreased in 2008 then slightly increased again in 2009 and 2010 **(Figure)**.

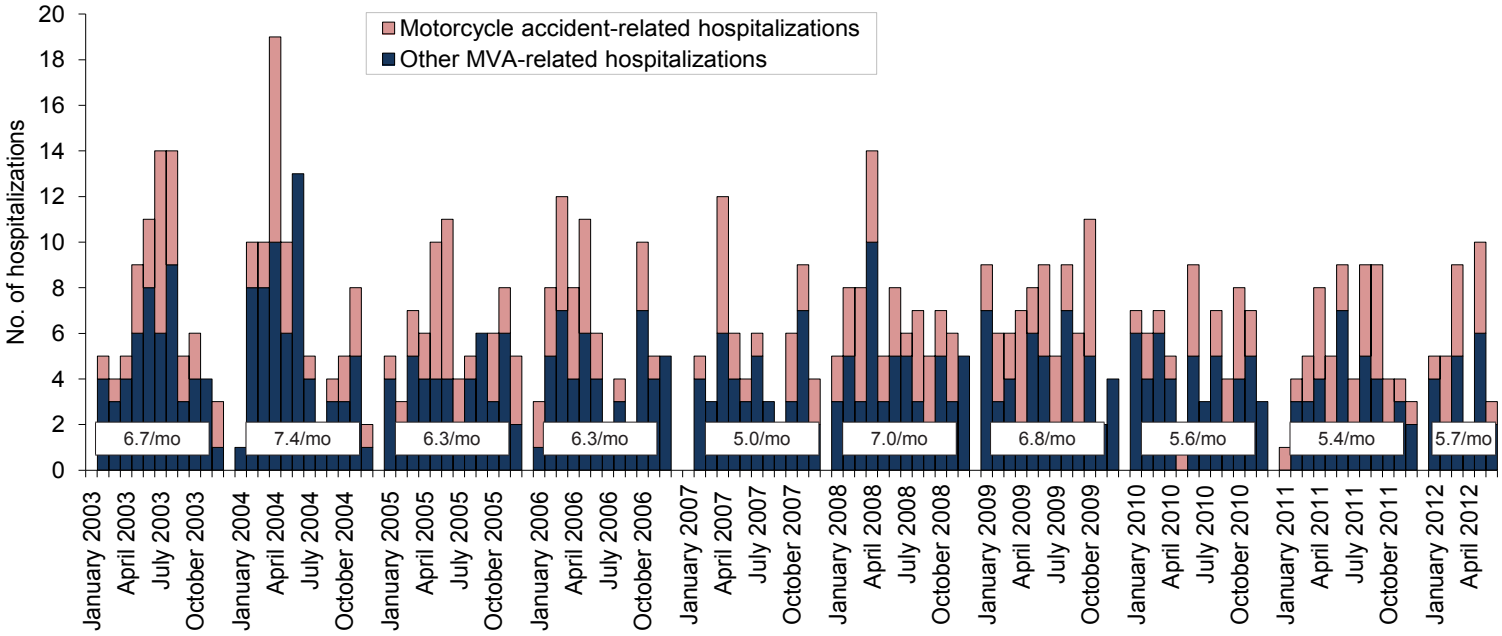
During the period the records of 24 women indicated that they had a "deployment-related" major amputation.[a]A majority of the deployment-related major amputations occurred in servicewomen who were in the active component (79.2%; n=19), in the Army (91.7%, n=22), aged 20-29 (75.0%, n=18), and enlisted (79.2%, n=19). Eight (33.3%) of the servicewomen with a deployment-related major amputation were involved in law enforcement occupations. The remaining 16 were distributed across eight different occupational groups **(data not shown)**.

1. Armed Forces Health Surveillance Center. Amputations of upper and lower extremities, active and reserve components, U.S. Armed Forces, 2000-2011. *Medical Surveillance Monthly Report (MSMR)*. 2012;19(6):2-6.

[a]Assessments of the causes of amputations and their relationships to deployment were based on cause of injury codes (i.e., E-codes and STANAG codes) and routinely collected deployment-related information. Because such data sources are incomplete and potentially inaccurate (e.g., exact start and end dates of deployments), there are undoubtedly misclassifications of relationships between amputations and deployment statuses.

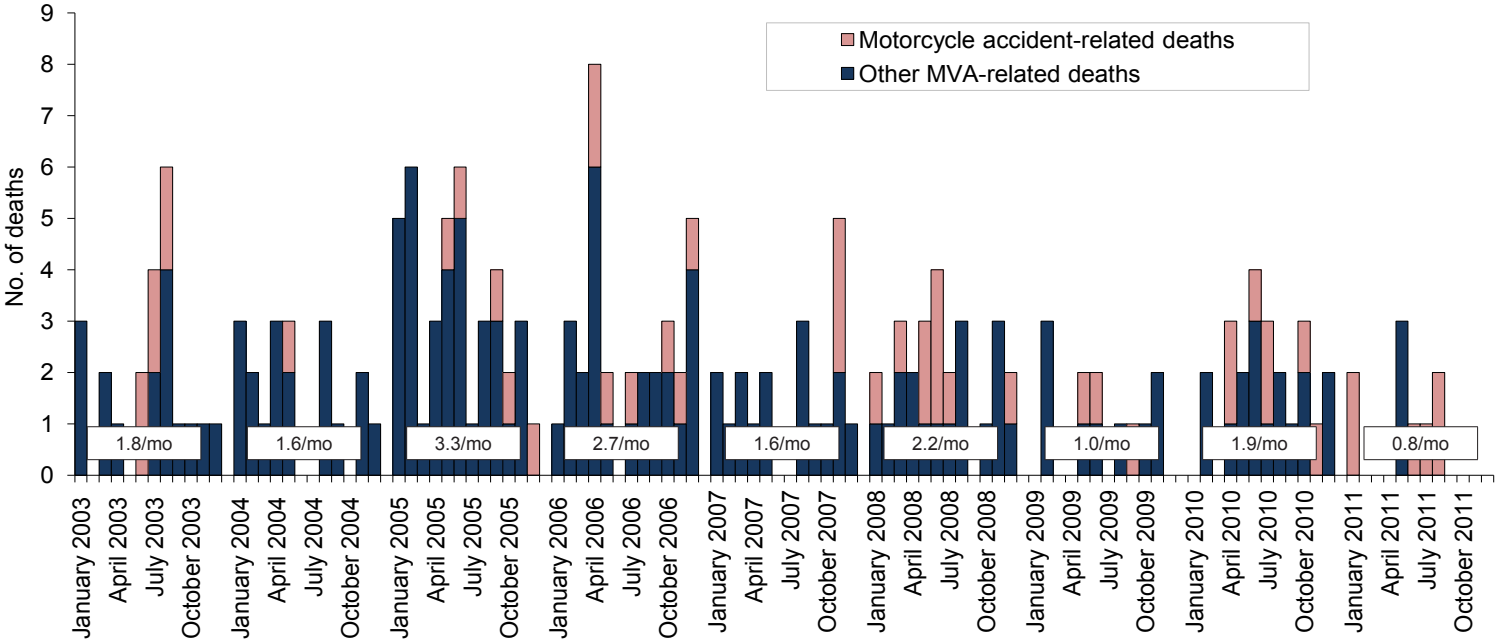
Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003-June 2012[a] (data as of 24 July 2012)

Hospitalizations outside of the operational theater for motor vehicle accidents occurring in non-military vehicles (ICD-9-CM: E810-E825; NATO Standard Agreement 2050 (STANAG): 100-106, 107-109, 120-126, 127-129)



Note: Hospitalization (one per individual) while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany within 10 days of another motor vehicle accident-related hospitalization.

Deaths[a] following motor vehicle accidents occurring in non-military vehicles and outside of the operational theater (per the DoD Medical Mortality Registry)



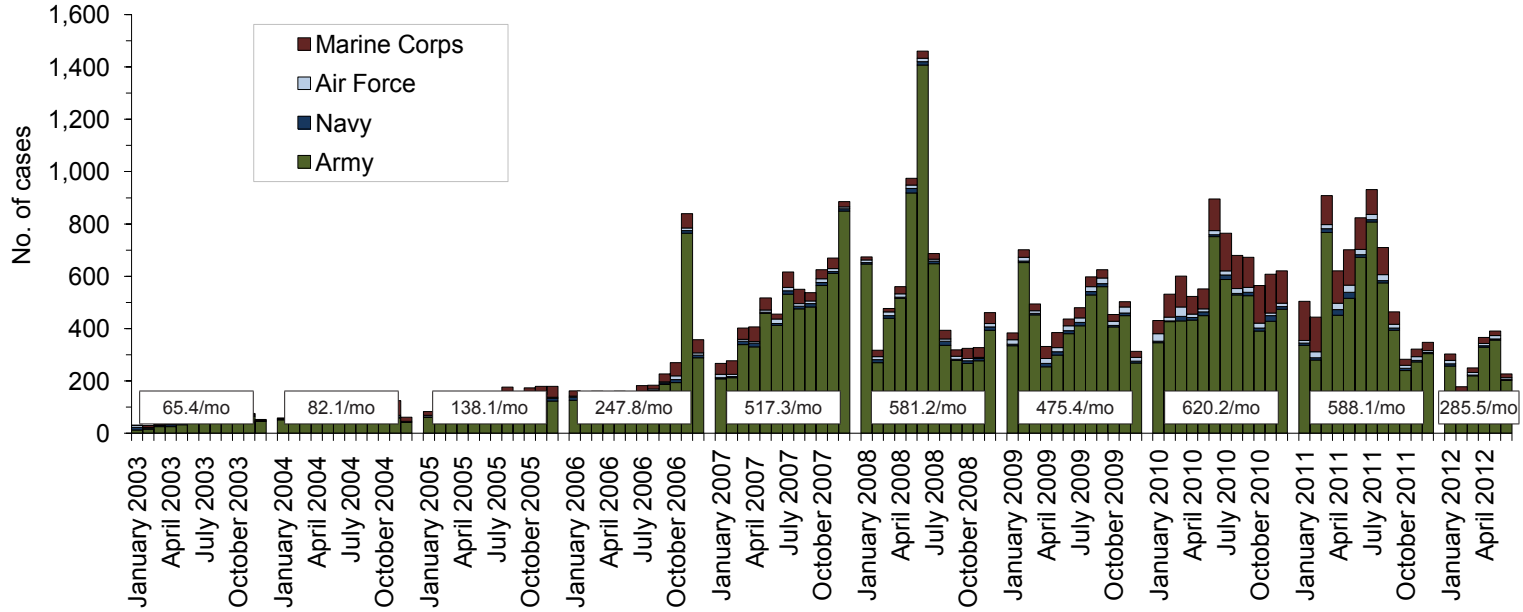
[a]Death data for 2012 is pending

Reference: Armed Forces Health Surveillance Center. Motor vehicle-related deaths, U.S. Armed Forces, 2010. *Medical Surveillance Monthly Report (MSMR)*. Mar 11;17(3):2-6.

Note: Death while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany within 10 days prior to death.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003-June 2012 (data as of 23 July 2012)

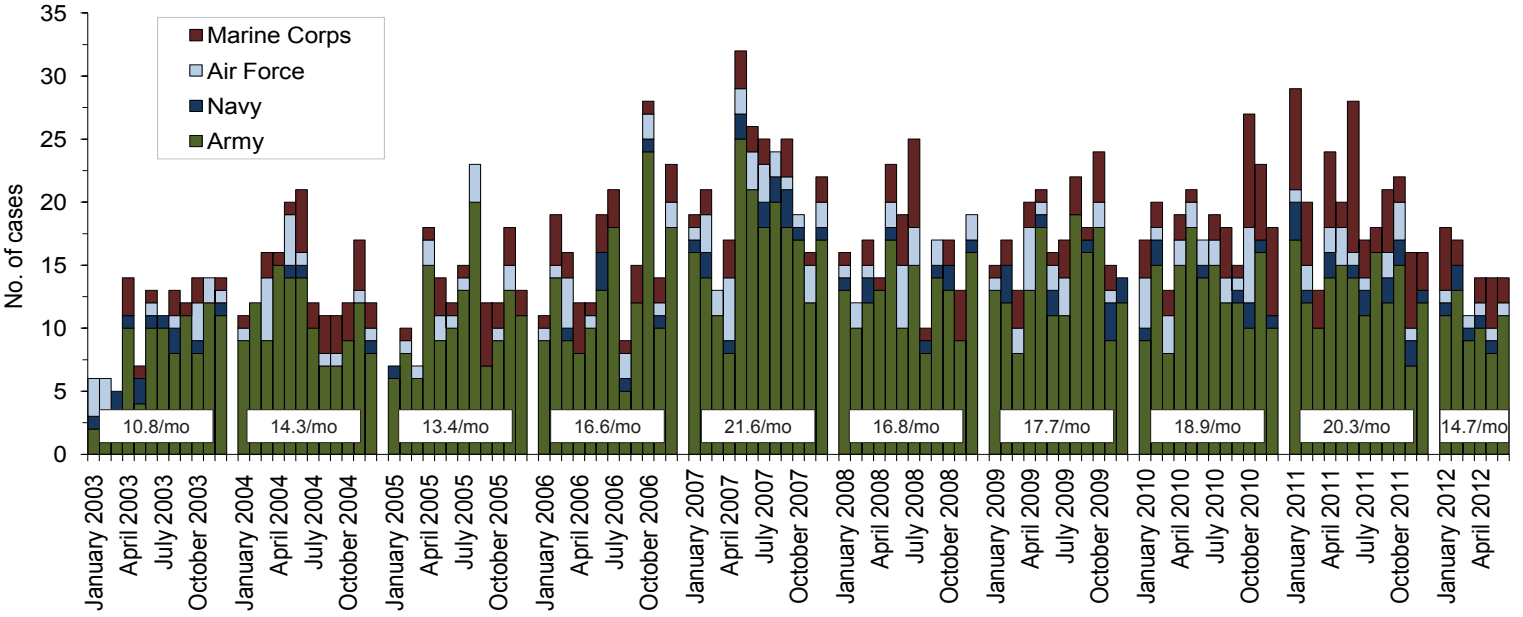
Traumatic brain injury (ICD-9: 310.2, 800-801, 803-804, 850-854, 907.0, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F, V15.52_0-9, V15.52_A-F, V15.59_1-9, V15.59_A-F)[a]



Reference: Armed Forces Health Surveillance Center. Deriving case counts from medical encounter data: considerations when interpreting health surveillance reports. *MSMR*. Dec 2009; 16(12):2-8.

[a]Indicator diagnosis (one per individual) during a hospitalization or ambulatory visit while deployed to/within 30 days of returning from OEF/OIF/OND. (Includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 3,754 deployers who had at least one TBI-related medical encounter any time prior to OEF/OIF/OND).

Deep vein thrombophlebitis/pulmonary embolus (ICD-9: 415.1, 451.1, 451.81, 451.83, 451.89, 453.2, 453.40 - 453.42 and 453.8)[b]

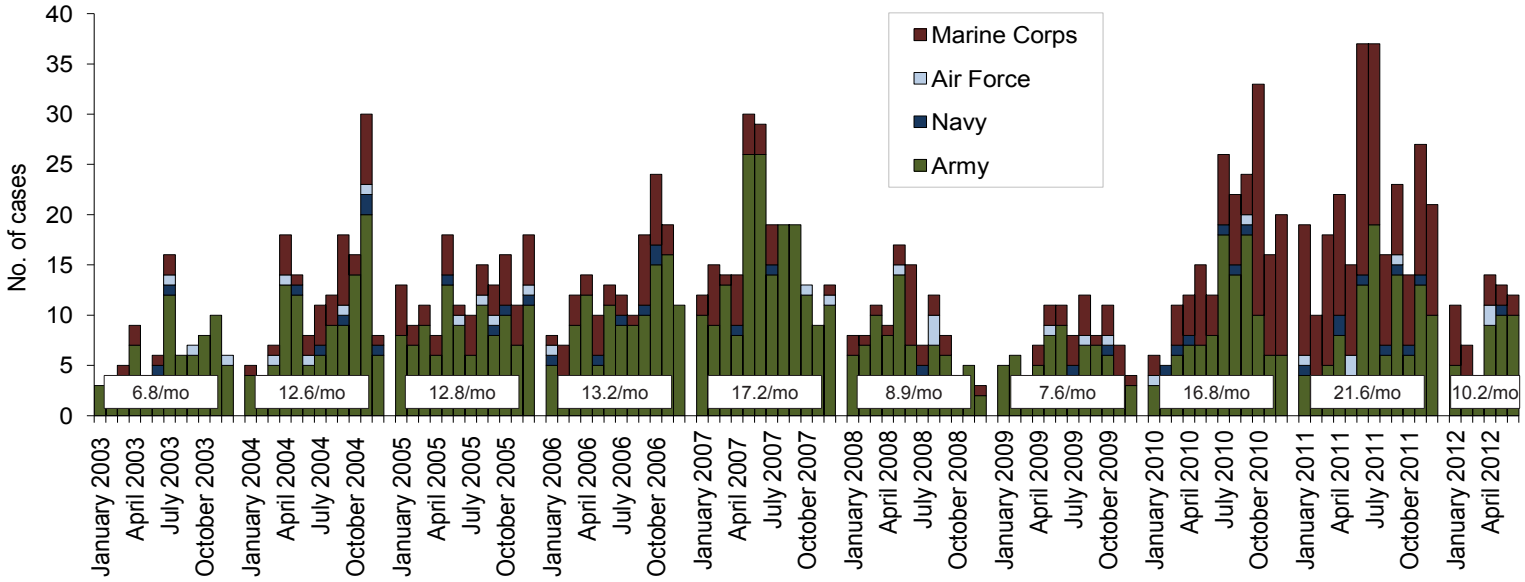


Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379-83.

[b]One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 90 days of returning from OEF/OIF/OND.

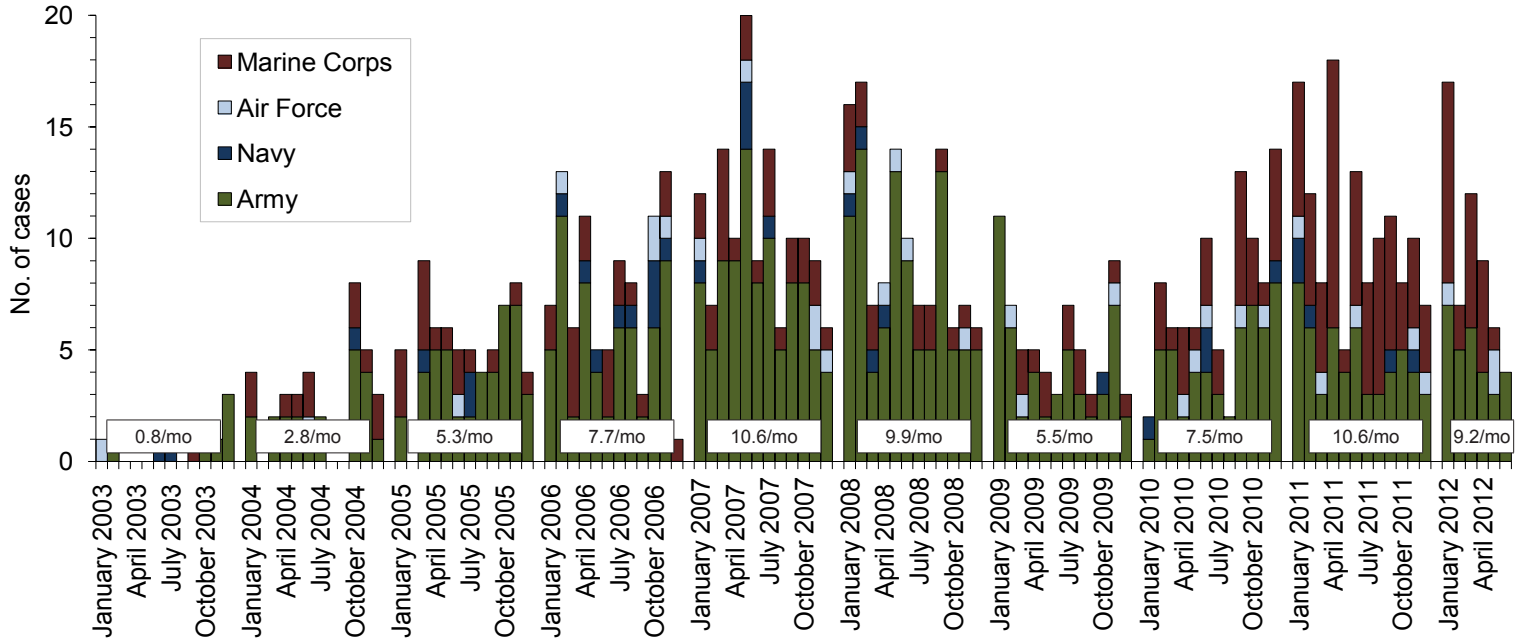
Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003-June 2012 (data as of 23 July 2012)

Amputations (ICD-9-CM: 887, 896, 897, V49.6 except V49.61-V49.62, V49.7 except V49.71-V49.72, PR 84.0-PR 84.1, except PR 84.01-PR 84.02 and PR 84.11)[a]



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: amputations. Amputations of lower and upper extremities, U.S. Armed Forces, 1990-2004. *MSMR*. Jan 2005;11(1):2-6.
[a]Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 365 days of returning from OEF/OIF/OND.

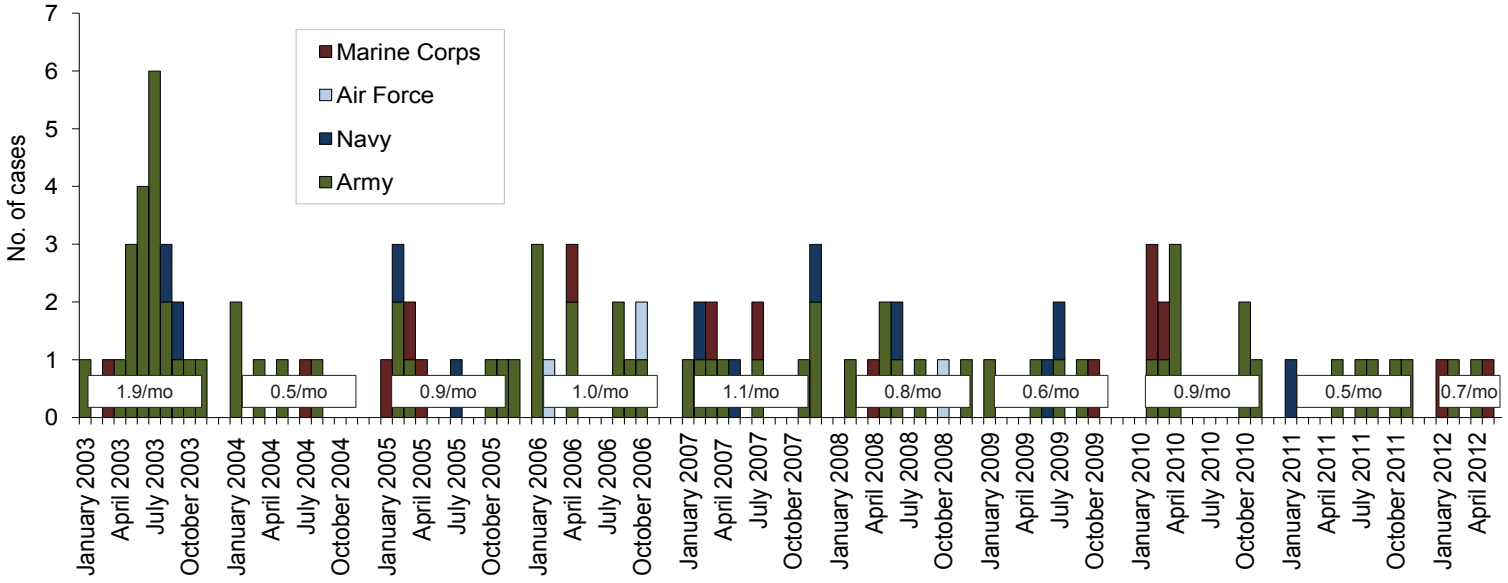
Heterotopic ossification (ICD-9: 728.12, 728.13, 728.19)[b]



Reference: Army Medical Surveillance Activity. Heterotopic ossification, active components, U.S. Armed Forces, 2002-2007. *MSMR*. Aug 2007; 14(5):7-9.
[b]One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 365 days of returning from OEF/OIF/OND.

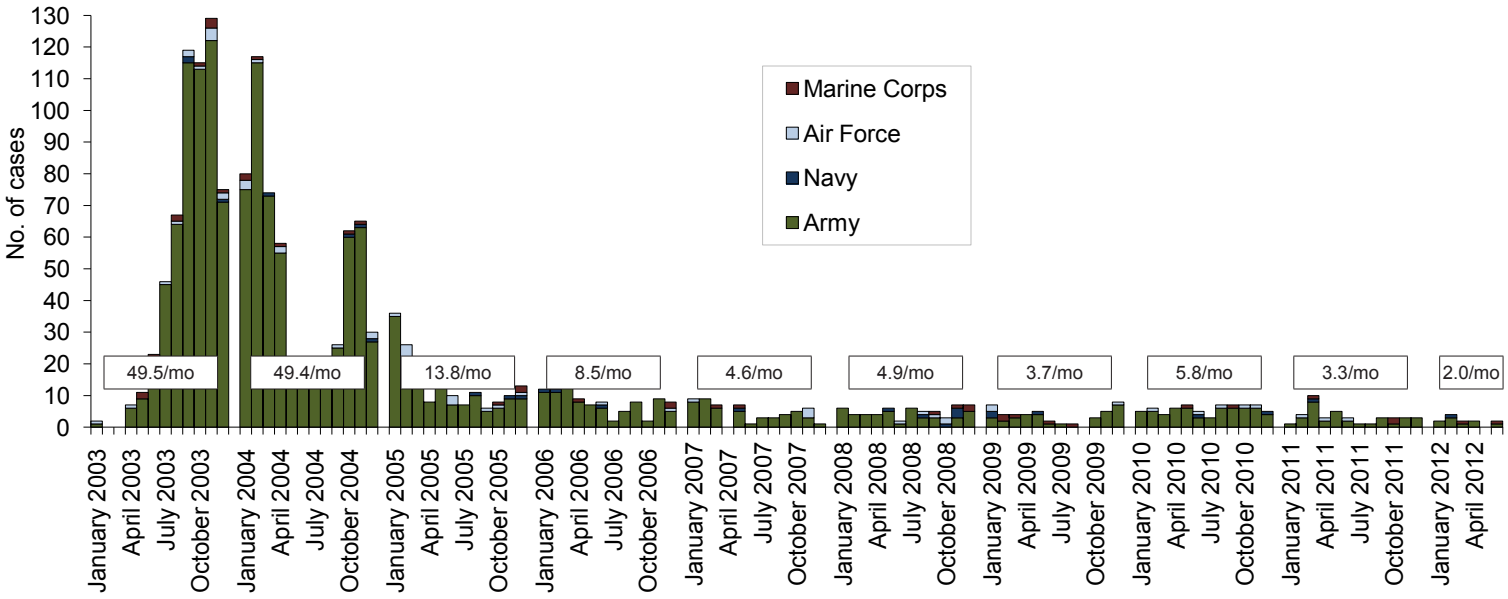
Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - June 2012 (data as of 23 July 2012)

Severe acute pneumonia (ICD-9: 518.81, 518.82, 480-487, 786.09)[a]



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: severe acute pneumonia. Hospitalizations for acute respiratory failure (ARF)/acute respiratory distress syndrome (ARDS) among participants in Operation Enduring Freedom/Operation Iraqi Freedom, active components, U.S. Armed Forces, January 2003-November 2004. *MSMR*. Nov/Dec 2004;10(6):6-7.
[a]Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 30 days of returning from OEF/OIF/OND.

Leishmaniasis (ICD-9: 085.0 to 085.9)[b]



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: leishmaniasis. Leishmaniasis among U.S. Armed Forces, January 2003-November 2004. *MSMR*. Nov/Dec 2004;10(6):2-4.
[b]Indicator diagnosis (one per individual) during a hospitalization, ambulatory visit, and/or from a notifiable medical event during/after service in OEF/OIF/OND.

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