NOVEMBER 2017

Volume 24
Number 11

MSMR

MEDICAL SURVEILLANCE MONTHLY REPORT

Women's Health Issue

Pregnancies and Live Births, Active Component Service Women, U.S. Armed Forces, 2012–2016

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This report summarizes data on the demographic and military characteristics of women and women of childbearing potential (WOCBP) in the active component of the U.S. Armed Forces during 2012–2016. Data on pregnancy-related care and birth rates are also presented. In 2016, WOCBP comprised the vast majority of active component service women. The largest proportions of WOCBP were in the categories of women who were 20–24 years old, non-Hispanic white, junior enlisted rank, and in a communications/intelligence occupation. WOCBP were roughly equally distributed in the Army, Navy, and Air Force, whereas only 7.5% served in the Marine Corps. Slightly more than one-quarter of WOCBP had ever deployed to the U.S. Central Command area of responsibility (CENTCOM AOR). In 2016, 13.1% of all WOCBP had at least one pregnancy-related event and 1.1% of deployed WOCBP had a pregnancy event during a deployment to CENTCOM AOR. The prevalence of pregnancy decreased slightly over the surveillance period. There were 63,879 live births during the surveillance period, for an overall live birth rate of 64.9 live births per 1,000 person-years (p-yrs). This rate of live births decreased steadily from 69.8 per 1,000 p-yrs in 2012 to 59.7 per 1,000 p-yrs in 2016. Rates of live births were highest among women who were 30–34 years old, enlisted or junior officer rank, Army, in healthcare occupations, and married. About one-quarter of the total live births were cesarean deliveries.

Although women have been able to serve officially in the U.S. military since 1901, both the number of women serving in the active component and their occupational roles have steadily increased and expanded. Currently, almost one in seven active component service members is female and more than 95% of military occupational specialties are open to women.[1,2]

As the numbers and roles of women in the military increased, a concomitant interest was generated in understanding and monitoring health issues specific to women, both in garrison and while deployed. An important step in this process is the ongoing and systematic surveillance of gender-specific health conditions among service women at a population (i.e., Department of Defense–wide) level.

This report is the first of four reports in this issue of the *MSMR* that focus on reproductive and gynecologic health issues in active component service women. This specific analysis summarizes data on the demographic and military characteristics of women in the active component of the U.S. Armed Forces, and separately reports these statistics for the subset of service women of childbearing age (i.e., 17–49 years). In addition, counts and proportions of service women receiving pregnancy-related care and birth rates are presented. Data are presented by year and for the entire surveillance period. The other three reports in this series provide data on contraception use, complications and care related to pregnancy and childbirth, and the incidence of gynecologic disorders.

METHODS

The surveillance period was 1 January 2012 through 31 December 2016. The surveillance population consisted of active component service women in the Army, Air Force, Navy, or Marine Corps who served at least 1 day during the surveillance period. From this cohort of active component service women, a subset of women of childbearing potential (WOCBP) was used for all subsequent analyses. WOCBP were defined as women aged 17–49 years without any history of hysterectomy prior to the start of the surveillance period.

Diagnoses were ascertained from administrative records of all medical encounters of individuals who received care in fixed (i.e., not deployed or at sea) medical facilities of the Military Health System (MHS) or civilian facilities in the purchased care system. All such records are maintained in the electronic database of the Defense Medical Surveillance System (DMSS). In-theater diagnoses were identified from the medical records of service members deployed to Southwest Asia whose healthcare encounters were documented in the Theater Medical Data Store (TMDS).

Hysterectomy was defined by the presence of any qualifying ICD diagnosis code, procedure code, or CPT code for hysterectomy in any diagnostic position of the record of a healthcare encounter in an outpatient or inpatient setting (including in-theater) **(Table 1)**. Women with a hysterectomy prior to the start of the surveillance period were excluded from the study population of WOCBP.

TABLE 1. ICD-9/ICD-10 diagnosis, procedure, and CPT codes used for hysterectomy

ICD-9 diagnosis	ICD-10 diagnosis
V88.01	Z90.710
V88.02	Z90.711
ICD-9 procedure[a]	ICD-10 procedure
683*–689*	0UT90ZZ, 0UT94ZZ, 0UT9FZZ, 0UT97ZZ, 0UT98ZZ, 0UT90ZL, 0UT94ZL, 0UT97ZL, 0UT98ZL, 0UT9FZL
CPT	
58150, 58152, 58200, 58210, 58240, 58260, 58262, 58263, 58267, 58270, 58275, 58280, 58285, 58290, 58291, 58292, 58293, 58294, 58541, 58542, 58543, 58544, 58548, 58550, 58552, 58553, 58554, 58570, 58571, 58572, 58573	

CPT, Current Procedural Terminology

[a]An asterisk (*) indicates any digit/character in this position.

TABLE 2. ICD-9/ICD-10 diagnosis, procedure, CPT, and DRG codes used for cesarean delivery

ICD-9 diagnosis	ICD-10 diagnosis
763.4, 669.7	P03.4, O82
ICD-9 procedure	ICD-10 procedure
74, 74.0, 74.1, 74.2, 74.4, 74.9, 74.99	10D00Z0, 10D00Z1, 10D00Z2
CPT	
59510, 59515, 59514, 00850, 00857, 01961, 01963, 01968, 01969	
DRG	
370, 371	

CPT, Current Procedural Terminology; DRG, Diagnosis-Related Group

The number and prevalence of WOCBP who had any qualifying pregnancy-related event during each calendar year of the surveillance period were calculated. The last demographic record for a given calendar year was used as the reference point to calculate percentages for demographic and military-related characteristics. For example, a WOCBP's marital status in 2013 was derived from the status recorded in her last demographic record in 2013. Qualifying pregnancy-related events were defined using ICD diagnosis codes in any diagnostic position during an inpatient, outpatient, or in-theater medical encounter (ICD-9: V22.0–V22.2,V23.*,V27.*, V72.42, 630*–679*; ICD-10: Z32.01, Z33.*–Z34.*, Z37.*, O00.*–O99.*, O9A.*) or by having a positive laboratory test result for human chorionic gonadotropin. Women who underwent a hysterectomy during the surveillance period were excluded from subsequent annual pregnancy prevalence calculations. For example, a woman who underwent a hysterectomy in 2012 would not be eligible to have a pregnancy-related event in 2013 or thereafter.

Pregnancy during deployment to the U.S. Central Command area of responsibility (CENTCOM AOR) was defined by having a qualifying pregnancy-related event (as defined above) between the start and end dates of the deployment, having a hospitalization for live-birth delivery (ICD-9: V27.*; ICD-10: Z37.* in any diagnostic position) within 180 days after the end of the deployment, or having a medical evacuation for pregnancy from the CENTCOM AOR theater of operations to any other theater outside of CENTCOM AOR. For each service woman, one pregnancy during deployment per year was counted. The country of deployment during pregnancy was estimated at the time of the first qualifying pregnancy event during each calendar year using the country information indicated in the deployment record. If the qualifying pregnancy event was a delivery that occurred within 180 days after a deployment, the country of pregnancy was estimated using the nearest preceding deployment record. Separately, for each woman who had a pregnancy-related medical encounter during a deployment, the average number of days from the start of deployment until the earliest qualifying pregnancy encounter for that deployment was calculated, as well as the average time until end of deployment.

Incidence rates of live birth deliveries per 1,000 person-years (p-yrs) among WOCBP were also calculated. An individual was eligible to be counted as having a new live birth once every 280 days. A live birth delivery was defined as having a hospitalization with ICD-9 codes V27.* or ICD-10 codes Z37.* in any diagnostic position. Encounters for deliveries that resulted in only still births (ICD-9: V27.1, V27.4, V27.7; ICD-10: Z37.1, Z37.4, Z37.7) were excluded. Codes used to define cesarean deliveries (C-sections) are presented in **Table 2**. Person-time was censored at the time of first hysterectomy diagnosis or procedure if a woman had a first-ever hysterectomy during the surveillance period.

RESULTS

Demographics

On 31 December 2016, there were 202,849 women serving in the active component of the Army, Navy, Air Force, or Marine Corps **(Table 3)**. Of these women, 197,947 (97.6%) were WOCBP. The distribution of demographic and military characteristics of the WOCBP were similar to those of all women serving in the active component. The largest proportions of WOCBP were in the categories of women who were 20–24 years old (34.3%), non-Hispanic white (43.4%), junior enlisted rank (46.5%), and serving in a communications/intelligence military occupation (32.3%). WOCBP were roughly equally distributed in the Army, Navy, and Air Force, whereas only 7.5% served in the Marine Corps. Slightly more than one-quarter (27.6%) of WOCBP had ever deployed to CENTCOM AOR. Slightly less than half (46.9%) of WOCBP were single and 56.5% had a high school education or less. During

TABLE 3. Numbers and percentages of all service women and women of childbearing potential (WOCBP), active component, U.S. Armed Forces, 31 December 2016

	All service women		WOCBP[a]	
	No.	%	No.	%
Total	202,849	100.0	197,947	100.0
Age (years)				
<20	20,882	10.3	20,882	10.5
20–24	67,899	33.5	67,885	34.3
25–29	47,923	23.6	47,826	24.2
30–34	31,068	15.3	30,732	15.5
35–39	19,800	9.8	18,964	9.6
40–44	9,332	4.6	8,333	4.2
45+	5,945	2.9	3,325	1.7
Race/ethnicity				
Non-Hispanic white	87,919	43.3	85,816	43.4
Non-Hispanic black	52,475	25.9	50,635	25.6
Hispanic	34,466	17.0	34,019	17.2
Asian/Pacific Islander	9,045	4.5	8,870	4.5
American Indian/Alaska Native	2,219	1.1	2,176	1.1
Other	16,725	8.2	16,431	8.3
Grade				
Junior enlisted (E1–E4)	92,188	45.4	92,097	46.5
Senior enlisted (E5–E9)	71,487	35.2	69,010	34.9
Junior officer (O1–O4)	32,595	16.1	31,722	16.0
Senior officer (O5–O10)	4,976	2.5	3,682	1.9
Warrant officer (W1–W5)	1,603	0.8	1,436	0.7
Ever deployed				
Yes	57,869	28.5	54,574	27.6
No	144,980	71.5	143,373	72.4
Service				
Army	67,487	33.3	65,168	32.9
Navy	59,713	29.4	58,693	29.7
Air Force	60,818	30.0	59,327	30.0
Marine Corps	14,831	7.3	14,759	7.5
Military occupation				
Infantry/artillery/combat engineering	4,417	2.2	4,387	2.2
Armor/motor transport	6,221	3.1	6,134	3.1
Pilot/air crew	2,981	1.5	2,958	1.5
Repair/engineering	42,008	20.7	41,558	21.0
Communications/intelligence	65,633	32.4	64,031	32.3
Health care	38,683	19.1	36,720	18.6
Other	42,906	21.2	42,159	21.3
Marital status				
Married	92,520	45.6	89,441	45.2
Single	93,642	46.2	92,792	46.9
Other	16,687	8.2	15,714	7.9
Education				
High school or less	112,440	55.4	111,788	56.5
College/other	90,409	44.6	86,159	43.5
Total no. who served at least 1 day in the military during 2012–2016				
No.	350,045		344,536	
Total no. who spent at least 1 day as a recruit in the military during 2012–2016				
No.	132,466		132,466	

[a]Less than 50 years old, no history of hysterectomy

the entire surveillance period of 2012–2016, a total of 344,536 unique WOCBP served at least 1 day in the military, and of those, 132,466 WOCBP spent at least 1 day as a recruit trainee.

Pregnancies

A total of 224,718 WOCBP served at any time during 2016. Of these, 13.1% had at least one pregnancy-related event during that year **(Table 4)**. The annual prevalence of pregnancy-related events decreased slightly over the 5-year surveillance period, from 14.2% in 2012 to 13.1% in 2016. In 2016, the highest prevalence of pregnancy-related events was among service women 30–34 years of age (16.8%) and among senior enlisted women (13.7%). Prevalence of pregnancy-related events was approximately evenly distributed among the race/ethnicity categories and military occupation groups. A slightly higher percentage of WOCBP in the Army (14.5%) had pregnancy-related events, compared with WOCBP in the other services. A higher percentage of women who were married (21.4%) had a pregnancy-related event, compared with those in the single (5.7%) or "other" (8.8%) categories. Only 0.2% of women who served during a recruit training period in any given year had a pregnancy-related event.

Pregnancies during deployment

In 2016, 1.1% of WOCBP who were deployed to CENTCOM AOR had a pregnancy during their deployment **(Table 5)**. The annual percentage of women with pregnancy events during deployment decreased marginally from 1.4% in 2012 to 1.1% in 2016. Among deployed WOCBP in 2016, the highest proportions of pregnancy events within the demographic categories in Table 5 occurred among women less than 20 years of age (3.7%), non-Hispanic black women (1.4%), enlisted personnel (1.2%), Army personnel (1.9%), those in motor transport (2.3%) or combat-related military occupations (2.6%), married women (1.2%), and those with a high school education or less (1.5%). However, the numbers of pregnancy events differed from the aforementioned proportions in three

TABLE 4. Numbers and percentages of service women of childbearing potential with at least one pregnancy-related event, active component, U.S. Armed Forces, 2012–2016

	2012		2013		2014		2015		2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Total	32,006	14.2	30,651	13.6	30,647	13.8	29,877	13.5	29,337	13.1
Age (years)										
<20	1,197	6.0	1,148	5.4	1,245	5.8	808	4.1	1,246	5.2
20–24	12,846	16.3	11,819	15.4	11,791	15.2	10,917	14.7	10,999	14.2
25–29	9,912	17.4	9,334	16.8	9,089	16.7	9,017	16.3	8,534	15.7
30–34	5,358	16.1	5,604	16.3	5,861	17.2	6,010	17.4	5,652	16.8
35–39	2,195	10.7	2,233	10.8	2,201	10.7	2,561	11.8	2,453	11.7
40–44	458	4.1	474	4.2	425	4.1	511	4.7	414	4.2
45-49	40	0.9	39	0.8	35	0.8	53	1.1	39	0.9
Race/ethnicity										
Non-Hispanic white	14,944	14.2	14,023	13.5	13,763	13.6	13,190	13.4	12,669	12.9
Non-Hispanic black	8,193	14.1	7,883	13.6	8,016	14.0	7,897	13.8	7,682	13.3
Hispanic	4,742	15.0	4,661	14.2	4,797	14.2	4,825	13.6	5,060	13.4
Asian/Pacific Islander	1,272	13.9	1,227	13.2	1,198	12.8	1,158	12.0	1,202	12.2
American Indian/Alaska Native	409	14.5	372	13.6	389	14.6	365	14.0	344	13.7
Other	2,446	13.5	2,485	13.4	2,484	13.4	2,442	13.3	2,380	13.0
Grade										
Junior enlisted (E1–E4)	16,297	15.1	14,798	13.9	14,383	13.8	14,014	13.3	13,801	12.8
Senior enlisted (E5–E9)	11,169	14.2	11,204	14.3	11,266	14.3	10,796	14.1	10,526	13.7
Junior officer (O1–O4)	4,168	12.6	4,308	12.8	4,625	13.6	4,663	13.7	4,623	13.5
Senior officer (O5–O10)	218	5.3	190	4.6	213	5.2	242	5.9	240	5.9
Warrant officer (W1–W5)	154	9.6	151	9.1	160	9.8	162	10.1	147	9.2
Service										
Army	12,972	15.8	12,050	15.0	11,873	15.3	11,674	15.2	11,094	14.5
Navy	7,518	12.5	7,430	12.1	7,869	12.5	8,070	12.3	8,116	12.3
Air Force	9,074	13.6	8,753	13.2	8,557	13.1	7,976	12.7	7,946	12.2
Marine Corps	2,442	14.9	2,418	14.6	2,348	13.9	2,157	12.9	2,181	12.7
Military occupation										
Infantry/artillery/combat engineering	620	12.6	463	11.8	485	11.7	563	12.7	613	12.1
Armor/motor transport	994	14.9	928	13.4	1,012	14.1	1,007	13.9	1,014	14.2
Pilot/air crew	351	11.5	348	11.4	393	12.5	374	11.8	370	11.7
Repair/engineering	6,326	15.0	6,201	13.7	6,260	13.5	6,387	13.7	6,343	13.3
Communications/intelligence	11,538	15.0	10,929	14.5	10,776	14.7	10,412	14.4	10,122	14.0
Health care	6,284	14.9	6,131	14.5	6,225	14.8	5,985	14.6	5,765	14.1
Other	5,893	12.0	5,651	11.8	5,496	11.8	5,149	11.0	5,110	10.5
Marital status										
Married	22,769	22.6	22,335	22.3	22,562	22.3	22,149	22.1	21,791	21.4
Single	7,102	6.9	6,470	6.2	6,308	6.2	6,031	5.9	5,951	5.7
Other	2,135	9.8	1,846	8.9	1,777	9.0	1,697	9.1	1,595	8.8
Education										
High school or less	21,146	15.4	19,517	14.6	18,878	14.5	17,940	14.0	17,381	13.4
College/other	10,860	12.3	11,134	12.3	11,769	12.8	11,937	12.8	11,956	12.6
Recruit[a]										
Yes	51	0.2	59	0.2	44	0.2	51	0.2	62	0.2

[a]Percentage of women who had a pregnancy-related event during period of recruit training, among the total number of female recruits who served that year

TABLE 5. Numbers and percentages of service women of childbearing potential with any pregnancy event during deployment, active component, U.S. Armed Forces, 2012–2016

	2012		2013		2014		2015		2016	
	No.	%	No.	%	No.	%	No.	%	No.	%
Total	343	1.44	182	0.99	104	0.81	77	0.85	76	1.05
Age (years)										
<20	26	2.84	12	1.99	10	2.44	7	2.55	10	3.72
20–24	165	1.98	86	1.36	49	1.14	37	1.25	27	1.15
25–29	102	1.48	47	0.87	29	0.79	23	0.86	28	1.37
30–34	33	0.86	22	0.73	10	0.46	6	0.38	5	0.38
35+	17	0.43	15	0.48	6	0.27	4	0.25	6	0.48
Race/ethnicity										
Non-Hispanic white	126	1.15	64	0.77	31	0.54	30	0.73	26	0.81
Non-Hispanic black	120	1.75	71	1.30	41	1.08	21	0.78	28	1.39
Hispanic	55	1.71	32	1.26	19	1.07	15	1.16	12	1.02
Other	42	1.48	15	0.70	13	0.88	11	1.07	10	1.19
Grade										
Enlisted (E1–E9)	316	1.65	163	1.12	92	0.93	69	0.96	69	1.22
Officer (O1–O10, W1–W5)	27	0.57	19	0.49	12	0.43	8	0.42	7	0.45
Service										
Army	272	1.97	148	1.33	84	1.15	53	1.24	63	1.94
Navy	17	0.96	9	0.82	3	0.55	2	0.71	1	0.34
Air Force	45	0.67	18	0.35	14	0.32	21	0.48	10	0.30
Marine Corps	9	0.54	7	0.64	3	0.51	1	0.45	2	0.51
Military occupation										
Infantry/artillery/combat engineering	9	1.50	6	1.65	4	1.57	3	1.52	4	2.55
Armor/motor transport	21	2.16	14	1.96	5	1.17	4	1.72	4	2.25
Pilot/aircrew	4	0.57	4	0.74	0	0.00	1	0.30	1	0.33
Repair/engineering	62	1.59	25	0.78	19	0.91	13	0.86	9	0.71
Communications/intelligence	145	1.47	85	1.12	46	0.87	28	0.73	43	1.37
Health care	39	1.26	16	0.63	7	0.41	9	0.85	6	0.75
Other	63	1.32	32	0.92	23	0.89	19	0.98	9	0.66
Marital status										
Married	193	1.84	89	1.10	48	0.83	39	0.95	39	1.23
Single	125	1.21	73	0.91	48	0.89	34	0.89	26	0.83
Other	25	0.81	20	0.84	8	0.49	4	0.34	11	1.19
Education										
High school or less	275	1.90	131	1.26	79	1.13	54	1.12	55	1.48
College/other	68	0.72	51	0.64	25	0.43	23	0.54	21	0.60

demographic categories in that the largest numbers were contributed by women in their 20s, non-Hispanic white and non-Hispanic black women, and women in communications/intelligence occupations **(Table 5)**. A total of 59 women were medically evacuated from a CENTCOM AOR for pregnancy during 2012–2016 **(data not shown)**.

For 29.9% of pregnancy events occurring during deployment, the country of deployment could not be determined. Of the deployments with identified locations, most pregnancy events occurred during deployment to Afghanistan (29.5%) or Kuwait (23.7%), followed by Qatar (7.5%) and United Arab Emirates (4.5%). Among all women with a pregnancy event during deployment, the median time from the deployment start date until the first pregnancy event was 132 days, and the median time until the end of deployment was 15 days **(data not shown)**.

Live births

There were 63,879 live births to WOCBP during the surveillance period **(Table 6)**, for an overall live birth rate of 64.9 live births per 1,000 p-yrs. The live birth rate decreased steadily from 69.8 per 1,000 p-yrs in 2012 to 59.7 per 1,000 p-yrs in 2016 **(Figure 1)**. The decrease was primarily driven by declining rates among women in their 20s. Overall, live birth rates were highest among women who were 30–34 years old, enlisted and junior officer, Army, in healthcare occupations, and married. Live birth rates were broadly similar among the race/ethnicity groups, although the overall rate was slightly higher among American Indians/Alaska Natives **(Table 6)**. No live birth deliveries occurred among service women during their recruit training period **(data not shown)**.

Of the 63,879 live birth deliveries, about three-quarters (75.3%) were vaginal deliveries and 24.7% were cesarean deliveries **(Table 6, Figure 2)**. During the surveillance period, the percentage of live births that were cesarean deliveries peaked in 2014 at 26.0%. The highest numbers of deliveries during the surveillance period occurred at Naval Medical Center Portsmouth, VA (7.4%), followed by Naval Medical Center San Diego, CA (6.1%), the Carl R. Darnall Army Medical Center, Fort Hood, TX (4.1%), Womack Army Medical Center, Fort Bragg, NC (3.8%), and Tripler Army Medical Center, Honolulu, HI (3.7%) **(Table 7)**.

EDITORIAL COMMENT

The vast majority of women (97.6%) serving in the active component of the military are women of childbearing potential. With the increasing numbers of service women and the expansion of roles available to women within the military, understanding the epidemiology of

TABLE 6. Live birth rate among service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016

	Total 2012–2016	
	No.	Rate[a]
Total	63,879	64.9
Age (years)		
<20	1,086	15.1
20–24	23,542	71.8
25–29	20,268	80.5
30–34	13,204	81.6
35–39	4,920	49.2
40–44	820	16.2
45–49	39	1.9
Race/ethnicity		
Non-Hispanic white	29,121	65.9
Non-Hispanic black	15,913	62.2
Hispanic	10,157	67.0
Asian/Pacific Islander	2,609	62.3
American Indian/Alaska Native	804	69.1
Other	5,275	64.0
Grade		
Junior enlisted (E1–E4)	30,108	66.0
Senior enlisted (E5–E9)	22,830	65.9
Junior officer (O1–O4)	10,245	65.4
Senior officer (O5–O10)	382	21.1
Warrant officer (W1–W5)	314	41.9
Service		
Army	24,375	71.5
Navy	16,243	58.5
Air Force	18,263	61.8
Marine Corps	4,998	70.8
Military occupation		
Infantry/artillery/combat engineering	1,086	56.8
Armor/motor transport	2,063	68.3
Pilot/air crew	853	59.6
Repair/engineering	13,114	66.4
Communications/ intelligence	22,525	68.3
Health care	13,097	69.8
Other	11,141	54.0
Marital status		
Married	49,001	110.9
Single	11,725	25.7
Other	3,153	36.0
Education		
High school or less	39,432	68.9
College/other	24,447	59.3

[a]Rate per 1,000 person-years

FIGURE 1. Live birth rate among service women of childbearing potential, by age group, active component, U.S. Armed Forces, 2012–2016

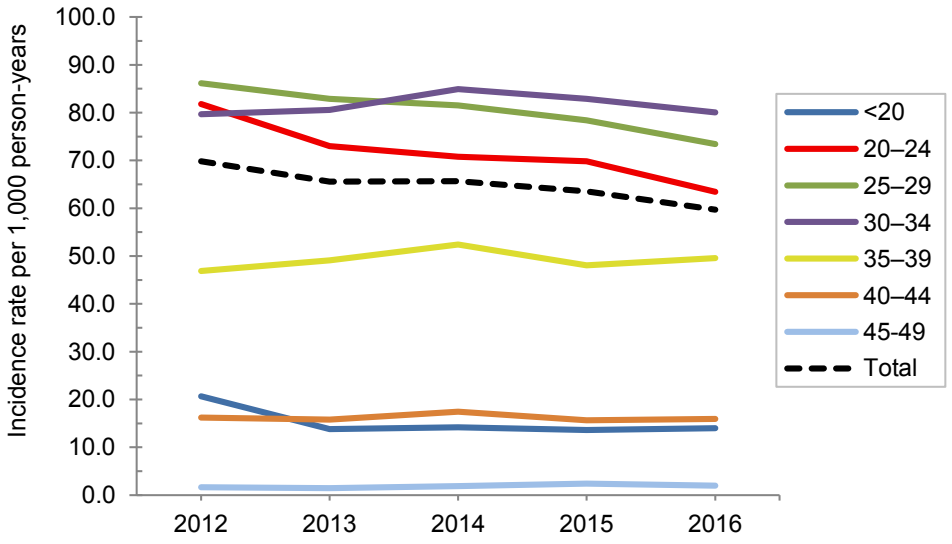

FIGURE 2. Number of live birth deliveries and live born infants among service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016

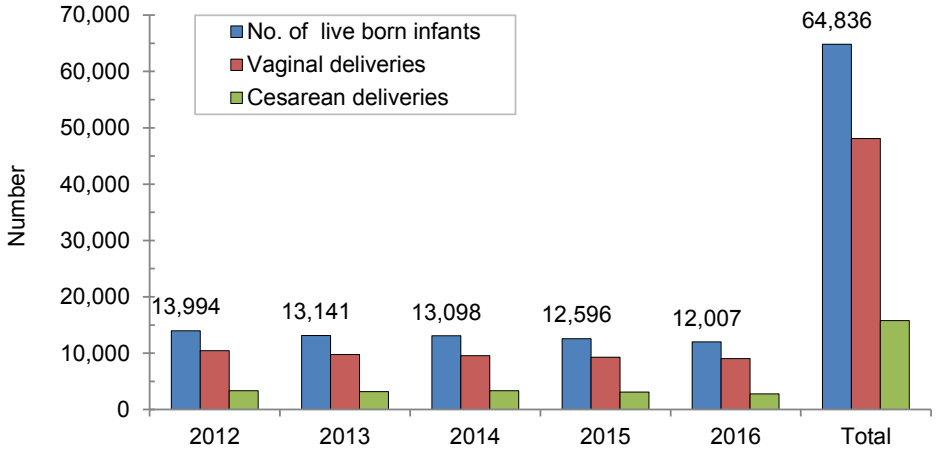

TABLE 7. Numbers and percentages of live birth deliveries, by military treatment facility, among service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016

Location	No.	% total
Naval Medical Center Portsmouth, VA	4,703	7.4
Naval Medical Center San Diego, CA	3,907	6.1
Carl R. Darnall Army Medical Center, Fort Hood, TX	2,602	4.1
Womack Army Medical Center, Fort Bragg, NC	2,455	3.8
Tripler Army Medical Center, Honolulu, HI	2,366	3.7
Madigan Army Medical Center, Joint Base Lewis-McChord, WA	1,931	3.0
Walter Reed National Military Medical Center, Bethesda, MD	1,867	2.9
Brooke Army Medical Center, Fort Sam Houston,TX	1,797	2.8
Evans Army Community Hospital, Fort Carson, CO	1,784	2.8
Blanchfield Army Community Hospital, Fort Campbell, KY	1,414	2.2
Naval Hospital Camp Lejeune, NC	1,446	2.3
William Beaumont Army Medical Center, Fort Bliss, TX	1,359	2.1
Fort Belvoir Community Hospital, VA	1,359	2.1
Winn Army Community Hospital, Fort Stewart, GA	1,291	2.0
Naval Hospital Camp Pendleton, CA	1,431	2.2
All other locations	32,167	50.4

pregnancy is important for both the health of U.S. service women and the readiness of the U.S. fighting force, two closely related issues. In addition to providing a snapshot of the overall reproductive health of the population, this report provides rates of pregnancy that are diagnosed during deployment—population-based data previously unavailable in the published literature.

During the 5-year surveillance period, the prevalence of pregnancies decreased; this was also reflected in the downward trend of the live birth rate from 69.8 per 1,000 person years to 59.7 per 1,000 person-years. Declining birth rates among women in their 20s primarily drove the overall trend of decreasing birth rates. A similar trend of declining birth rates is apparent in the U.S. population as a whole, where birth rates decreased overall and reached a record low in 2015 for teenagers aged 15–19 years and for women in their 20s.[3] Also consistent with the results of the current study is that birth rates among women in the general U.S. population rose or remained relatively stable for women in their 30s and 40s.[3] Neither the reasons for the shift in births from younger to older mothers nor the long-term implications of this trend are entirely clear.

In the other demographic categories, junior and senior enlisted, junior officers, and married women had higher live birth rates, compared to other ranks and single women. The prevalence of pregnancies for single women decreased each year of the surveillance period and the live birth rate for single women (25.7 per 1,000 p-yrs) was lower than the birth rate among unmarried women in the U.S. general population (43.4 per 1,000 women) overall in 2015.[3]

There has been a concerted effort over the past decade to reduce the rate of cesarean deliveries, given the higher morbidity and mortality that can occur with both repeat cesarean deliveries and vaginal birth after cesarean. During 2012–2016, most deliveries among service women were vaginal, while approximately a quarter of deliveries were by cesarean section. The percentage of deliveries that were cesarean peaked in 2014 at 26.0% and then decreased to 23.4% in 2016. During the same time period, cesarean delivery rates in the U.S. population were consistently more than 30%; the rate of 32.0% in 2015 was the lowest rate since 2007.[3] Efforts within the MHS to keep cesarean delivery rates low should be continued and balancing measures (i.e., unintended consequences such as complication rates from vaginal deliveries) should be monitored to ensure the highest quality of safe care for mothers and their children.

Pregnancies diagnosed during deployment have significant implications for both the individual service woman and the mission and, yet, until now, population-based data were not available with which to estimate the frequency of this occurrence. Women who learn they are pregnant during a deployment face the prospect of delay in appropriate prenatal care and complications during early pregnancy for which medical support may not be ideal. Delay in prenatal care during deployment may result in missed opportunities for key components of care, such as vitamin supplementation and indicated screening tests. In addition, complications such as miscarriage and ectopic pregnancy may be more difficult to diagnose and treat in theater. Given the importance of early and appropriate prenatal care to the health of the woman and her fetus, and the lack of such care in many deployed settings, women who are diagnosed with pregnancy in theater are evacuated via airplane and sent to a non-deployed setting as soon as is feasible. Such evacuation can have an impact on the deployed mission until the individual can be replaced in theater or other accommodations are made.

The methodology used here was intended to capture information on active component WOCBP who conceived during deployment as well as those who conceived before being deployed but were not diagnosed with pregnancy until during deployment. Information on women who became pregnant during deployment, were not diagnosed in theater, and who miscarried or terminated their pregnancies may not be captured in these data. On the other hand, women who conceived after returning from deployment and who delivered within 180 days of returning from deployment (i.e., delivering extremely preterm) may be counted as pregnancies in theater, although this number is likely to be extremely small.

During the surveillance period, between 1.1% and 1.4% of deployed active component WOCBP had a pregnancy event annually. This proportion contrasts with the finding that among all WOCBP at least 13% had pregnancy encounters per year. In most of the demographic categories, the distributions of pregnancy events among deployed WOCBP were consistent with the distributions of numbers and proportions of women who became pregnant while on routine (non-deployed) duty. Although the proportion of WOCBP who had pregnancy events was highest in the youngest deployed women, three to five times as many deployed women in their 20s had pregnancy events. These findings are in agreement with a previous study among U.S. active component service women, which found that younger and less educated women were at higher risk of unintended pregnancy than their respective counterparts.[4]

It is commonly thought that pregnancies in theater are more likely to be unintended, although pregnancy intendedness cannot be surmised from administrative data. Nevertheless, given the potential maternal and fetal risks as well as the potential impact on mission, efforts to reduce the number of pregnancies diagnosed in theater should continue. In a recent study on contraception prescriptions for service women both during deployment and in garrison, the characteristics of women least likely to be prescribed contraception before or during deployment were young age (17–19 years), single marital status, lower enlisted rank, and Army service—many of the same demographic and military characteristics of women in this report who were more likely to get pregnant during deployment.[5] This observation highlights a need to ensure that subsets of women at increased risk for unintended pregnancy have access to counseling and the full range of contraceptive services when they need it and, in particular, before a deployment.

Incidence of pregnancies is challenging to capture using administrative data; as such, only prevalence is estimated here. Another significant limitation of this study is that deployments to locations other than CENTCOM AOR are not included in the analysis, thereby underestimating the overall pregnancy rate during deployments to theaters of operation in general. Although examining CENTCOM AOR deployments is important, other theaters of operation may have unique challenges that alter the picture seen in just one deployed setting. Pregnancies diagnosed aboard ship are also not likely to be captured in these data.

Overall, this report presents findings intended to increase understanding and monitoring of health issues specific to women across DoD, both in garrison and while deployed. Future reports will further contribute to ongoing and systematic surveillance of gender-specific health conditions among service women.

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Contraception Among Active Component Service Women, U.S. Armed Forces, 2012–2016

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This report summarizes the annual prevalence of permanent sterilization, as well as use of long- and short-acting reversible contraceptives (LARCs and SARCs, respectively), contraceptive counseling services, and use of emergency contraception from 2012 through 2016 among active component U.S. service women. Overall, 262,907 (76.2%) women of childbearing potential used either a LARC or a SARC at some time during the surveillance period. From 2012 through 2016, permanent sterilization decreased from 4.2% to 3.6%; LARC use increased from 17.2% to 21.7%; SARC use decreased from 38.5% to 30.4%; and emergency contraception use increased from 0.4% to 1.9%. Annual prevalence of contraceptive counseling only was relatively stable around 4.0%. This report estimates the length of continuation of LARCs, demonstrating that 86.1% continued their intrauterine device at 12 months, 78.5% at 24 months, and 73.4% at 36 months. These data demonstrate that the vast majority of service women have utilized at least one form of contraception, and that women are selecting LARCs in greater numbers with each passing year. The prevalence of contraceptive utilization among deployed service women is also reported.

More than 200,000 women serve in the active component of the U.S. military, comprising more than 16% of the active component force.[1] Because the majority of women serving in the Armed Forces are of childbearing age, and women's military career opportunities have expanded into combat roles, contraceptive health care is an increasingly important public health issue.

All U.S. service women have access to universal, no-cost health care including contraceptive coverage. All prescription contraceptive methods, including long-acting reversible contraceptives (LARCs), are available at no cost in military treatment facilities. Despite this fact, estimated rates of unintended pregnancy among service women are approximately 50% higher than age-adjusted estimates in the U.S. general population.[2,3] Unintended pregnancy can have a significant detrimental effect on military unit operations and readiness, especially in the deployed setting. For example, a pregnant service woman is ineligible to deploy and must be evacuated from the theater of operations if she becomes pregnant during deployment.

The Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS) provides population-level estimates of contraceptive use among U.S. women. Using data collected between 2006 and 2010, the NCHS estimated that 62% of women of childbearing age used contraceptives. The most common methods used were oral contraceptives (i.e., the pill) and sterilization, used by 28% and 27% of women, respectively.[4] Until this year, similar population-based estimates of contraceptive use were unavailable for women in the U.S. military. Witkop et al. recently published the findings from a comprehensive analysis of contraceptive use among women of childbearing potential in the U.S. military.[5] The authors used administrative medical data from the Defense Medical Surveillance System (DMSS) about prescriptions and ICD-9-coded contraceptive-related procedures, diagnoses, and counseling to derive estimates of contraceptive utilization between 2008 and 2013. The analysis found that more than three-quarters (76.9%) of active component military women used at least one form of contraception during the study period; short-acting reversible contraceptives (SARCs) (e.g., birth control pills, patches, injectables) were the most frequently used method (55.6%).[5]

This report used methodology similar to that used by Witkop et al. to estimate the proportion of service women who were prescribed contraceptives during 2012–2016. Data pertaining to contraceptive use were stratified by demographic and military characteristics, as well as by contraceptive method (e.g., permanent, long-acting, short-acting). Data also were stratified by year to assess temporal trends.

METHODS

The surveillance period was 1 January 2012 through 31 December 2016. The study population consisted of all active component service women aged 17–49 years who served in the Army, Navy, Air Force, or Marine Corps at least 1 day during the surveillance period. Women with a history of hysterectomy prior to the start of the surveillance period were excluded.[6] Women who underwent a hysterectomy during the surveillance period were excluded from subsequent annual contraceptive use prevalence calculations. For example, a woman who underwent a hysterectomy in 2012 was not eligible to be counted for contraceptive use in 2013 or thereafter.

Service members were identified as using contraception on the basis of database documentation of one or more of the following: 1) receipt of a prescription for contraception (per American Hospital Formulary Service Pharmacologic-Therapeutic Class: 681200)[7]; 2) an ICD-9/ICD-10 procedure, diagnostic, or counseling code for insertion, continued use, or surveillance

of contraception **(Table 1)**; or 3) receipt of a diagnostic, procedural, or CPT code for permanent sterilization **(Table 2)**. LARCs included intrauterine devices (IUDs) and implants, whereas SARCs included oral contraceptives, patches, vaginal rings, and injectables. Barriers included diaphragms and cervical caps. ICD-9/ICD-10 diagnostic codes used to define contraceptive counseling included codes for general counseling and advice (ICD-9: V25.0–V25.02, V25.04, V25.09; ICD-10: Z30.02, Z30.09). The codes used to define emergency contraception use were ICD-9: V25.03 and ICD-10: Z30.012.

Prescription information was obtained from the Pharmacy Data Transaction Service, a central data repository that contains medication records for all TRICARE beneficiaries, regardless of point of service (i.e., military, retail, and mail-order pharmacies). Procedure, diagnostic, and CPT codes were identified in the records of the DMSS, including the Theater Medical Data Store (TMDS), which collectively contain data on hospitalizations and ambulatory visits by actively serving members in U.S. military and civilian (i.e., contracted or purchased care through the Military Health System [MHS]) medical facilities worldwide, including combat theaters of operation.

Descriptive statistics were used to describe the overall proportion of women utilizing contraception and the proportion by age, race/ethnicity, military rank, service branch, military occupation, marital status, educational attainment, and contraceptive method (permanent, long-acting, short-acting, barrier, and counseling). To identify time trends and to account for the long surveillance period, utilization data were also stratified and analyzed by calendar year.

Individuals who used multiple types of contraceptives during a given calendar year were assigned to mutually exclusive groups, with group assignment as follows: (*in decreasing order of priority*) permanent sterilization, LARCs, SARCs, barrier, and contraceptive counseling, respectively. Emergency contraception use was measured independently from the other categories of contraceptives. Time-dependent variables, such as age and military rank, were determined at the end of each calendar year for the annual calculations of prevalence percentages.

An individual was considered to be permanently sterilized from the first day of the medical encounter for permanent sterilization (via bilateral tubal ligation, oophorectomy, or salpingectomy) until the end of military service or the end of the surveillance period, whichever came first. For long-acting, short-acting, and barrier contraceptives, periods of contraceptive coverage were created based on the "days' supply" for a given contraceptive type. IUDs were assigned a default 3-year days' supply; however, Mirena® and Kyleena™ brands were assigned a 5-year day's supply and ParaGard® brand was assigned a 10-year days' supply. Implants were assigned a default 3-year days' supply except for both Norplant® and Jadelle® implants, which were assigned a 5-year days' supply. The coverage period was censored on the date that the implant or IUD was removed, if there was any documentation of a removal in ICD diagnostic, procedural, or CPT codes. For vaginal rings and patches, days' supply ranged from 30 days to 1 year. For oral contraceptives, days' supply ranged from 28 days to 1 year. An individual was considered to have received contraceptive counseling only for the given calendar year if there were no other contraceptive types with coverage periods during that year. Finally, a woman was considered to have used emergency contraception for a given year if she had a medical encounter or dispensed prescription for emergency contraception at any time during that year.

Utilization was also assessed among a subset of service women who deployed during the surveillance period, using deployment start dates as recorded in deployment records from the Contingency Tracking System of the Defense Manpower Data Center and archived in the DMSS. Among women who deployed during the surveillance period, the prevalence of those who were covered by contraceptives during deployment for any

TABLE 1. ICD-9/ICD-10 diagnosis, procedure, and CPT codes for contraceptive insertion, continued use, and removal

	IUD insertion	IUD continued use	IUD removal
ICD-9 diagnosis	V25.11, V25.13	V25.42, V45.5, V45.51, 996.32	V25.12
ICD-10 diagnosis	Z30.014, Z30.430, Z30.433	Z30.43, Z30.431, Z97.5, T83.31XA, T83.31XD, T83.31XS, T83.32XA, T83.32XD, T83.32XS, T83.39XA, T83.39XD, T83.39XS	Z30.432
ICD-9 procedure	69.7	—	—
ICD-10 procedure	0UH97HZ, 0UH98HZ, 0UHC7HZ, 0UHC8HZ	—	—
CPT	58300	—	58301
	Implant insertion	Implant continued use	Implant removal
ICD-9 diagnosis	V25.5	V25.43, V45.52	—
ICD-10 diagnosis	Z30.017	Z30.46	—
CPT	11975, 11981, 11983, 11977	—	11976, 11982
	Patch insertion	Patch continued use	
ICD-10 diagnosis	Z30.016	Z30.45	
	Vaginal ring insertion	Vaginal ring continued use	
ICD-10 diagnosis	Z30.015	Z30.44	
	Injectable insertion	Injectable continued use	
ICD-10 diagnosis	Z30.013	Z30.42	
	Barrier insertion	Barrier continued use	
CPT	—	57170	

IUD, intrauterine device; CPT, Current Procedural Terminology

TABLE 2. ICD-9/ICD-10 diagnosis, procedure, and CPT codes used for permanent sterilization

ICD-9 diagnosis	ICD-10 diagnosis
V25.2	Z30.2
ICD-9 procedure[a]	ICD-10 procedure
65.5*, 65.6*, 66.2*, 66.3*, 66.5*	0UL74ZZ, 0U574ZZ, 0U578ZZ, 0UL74CZ, 0UL74DZ, 0UL74ZZ, 0UL78DZ, 0UL78ZZ, 0UL78ZZ, 0UL70ZZ, 0U570ZZ, 0U573ZZ, 0U577ZZ, 0UL70CZ, 0UL70DZ, 0UL70ZZ, 0UL73CZ, 0UL73DZ, 0UL77DZ, 0UL77ZZ, 0UL73ZZ, 0UL77ZZ, 0UT70ZZ, 0UT74ZZ, 0UT77ZZ, 0UT78ZZ, 0UT7FZZ, 0UT20ZZ, 0UT24ZZ, 0UT27ZZ, 0UT28ZZ, 0UT2FZZ
CPT	
58611, 58615, 58670, 58671	

CPT, Current Procedural Terminology

[a]An asterisk (*) indicates any digit/character in this position.

period of time was assessed. To account for different effective durations of contraceptive methods, deployment utilization was defined as follows: deployed during a period of contraceptive coverage as calculated above; or, within 6 months of deployment, received a prescription or code for a SARC, diaphragm, cervical cap, or contraceptive counseling. A woman was considered to have used emergency contraception during deployment if she had a medical encounter or was dispensed a prescription for emergency contraception at any time between the deployment start and end dates.

The percentages of women who discontinued LARCs at or before 12, 24, and 36 months from insertion were calculated. The time of discontinuation was calculated from the date of the first insertion code to the date of the first subsequent removal code for each individual during the surveillance period. For these calculations, women who had LARC insertion dates less than 12, 24, or 36 months from the end of the surveillance period were excluded. Finally, the number and percentage of service women who discontinued SARCs also were calculated. For each calendar year, if there was a gap of more than 30 days between the calculated coverage dates of dispensed prescriptions (based on days' supply), then the individual was considered to have discontinued for that year. Calculations were done separately for each type of SARC.

RESULTS

There were roughly 225,000 service women of childbearing potential in any given year of the surveillance period, and almost 345,000 different women who served at any time between 2012 and 2016 **(Figure 1, data not shown)**. A total of 320,556 (92.9%) women used at least one form of contraception at some point during the surveillance period, including barrier and counseling methods. Of the women of childbearing potential who served during the period, 262,907 (76.2%) of them used either a LARC or SARC method **(data not shown)**.

Permanent sterilization

During any given year of the surveillance period, an average of 4.0% of women in service had been permanently sterilized; this prevalence decreased slightly throughout the 5-year surveillance period from 4.2% in 2012 to 3.6% in 2016 **(Table 3, Figure 1)**. Permanent sterilization was most prevalent among women aged 40–44 years. Overall, the proportions of permanent sterilization were highest among non-Hispanic black women, warrant officers, those in communications/intelligence or healthcare occupations, those who completed some college or more, and those with "other" marital status (primarily widowed or divorced). Women serving in either the Air Force or Army had slightly higher prevalence of permanent sterilization than those in the Navy or the Marine Corps. No recruit trainees were identified as having been permanently sterilized during the surveillance period **(data not shown)**.

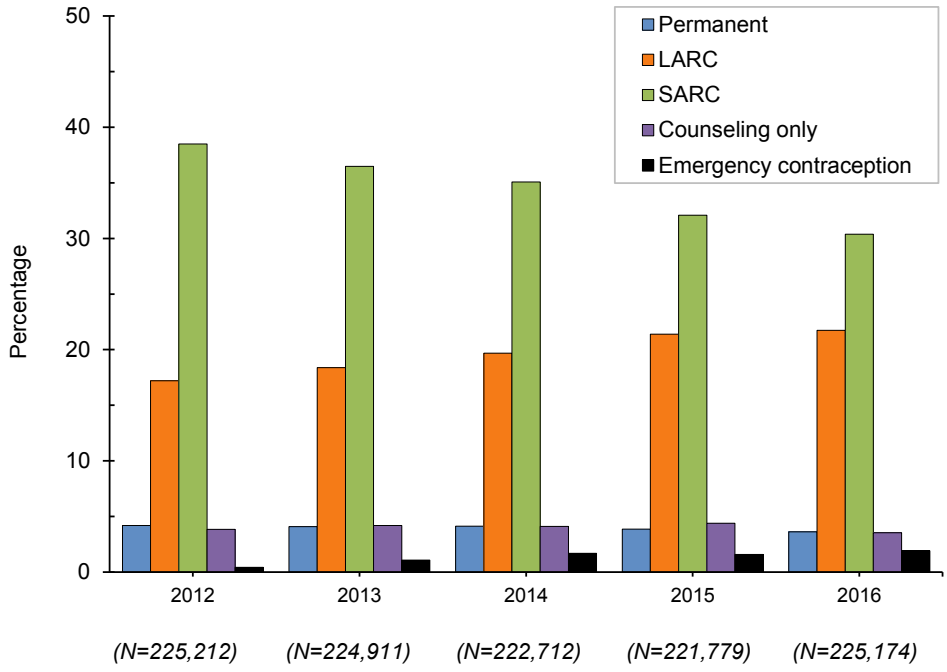
The average annual prevalence of permanent sterilization among women who deployed during any given year of the surveillance period (4.2%) was similar to the prevalence of permanent sterilization among service women overall **(Table 4, Figure 2)**. Among deployed women, permanent sterilization was most common among the same subgroups as among all women of childbearing potential; however, among deployed women, permanent sterilization was most common among those in armor/motor transport occupations.

LARCs

The percentage of women who used either IUDs or implants increased from 17.2% in 2012 to 21.7% in 2016, with an average annual prevalence of 19.7% **(Figure 1, Table 5)**. Overall, LARC use was most common among women aged 25–29 years. The prevalence increased among all age groups over the course of the surveillance period. In 2016, LARC use was slightly higher among women aged 20–24 years (24.5%), compared to those aged 25–29 years (24.4%). LARC use was most common among American Indians/Alaska Natives, Hispanics, senior enlisted personnel, those in healthcare occupations, and those with "other" marital status. Women in the Marine Corps (23.6%) or the Navy (22.7%) had higher annual prevalences of LARC use than women in the Air Force (19.5%) or the Army (16.5%). During the surveillance period, approximately 4% of recruit trainees had a prescription for a LARC or a medical encounter for LARC insertion or removal.

Among deployed women, the average annual prevalence of LARC use during the surveillance period was 17.9% **(Table 4)**. As was true for all active component women of childbearing potential, LARC use among deployed women was lowest among Asians/Pacific Islanders, Army members, and was highest among senior enlisted personnel and those with an "other" marital status. **(Table 4)**.

FIGURE 1. Annual prevalence of contraceptive utilization, by type, service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016



LARC, long-acting reversible contraceptive; SARC, short-acting reversible contraceptive

SARCs

The annual prevalence of SARC use among service women decreased from 38.5% in 2012 to 30.4% in 2016 **(Figure 1, Table 6)**. SARC use was most common among women aged 17–19 years, junior officers, those in pilot/air crew occupations, and single women. The percentage of SARC use was relatively evenly distributed among the race/ethnicity categories although slightly higher among non-Hispanic whites and "other." In addition, SARC use was slightly higher among women in either the Air Force (37.1%) or Navy (36.2%) than among women in either the Marine Corps (33.5%) or Army (31.2%). The percentage of female recruit trainees who had a prescription or medical encounter for SARC decreased from 16.2% in 2012 to 8.1% in 2016 **(Table 6)**.

Among deployed women, the average annual prevalence of SARC use during the surveillance period was 28.0% **(Table 4)**. The highest proportions of SARC use among deployers occurred among women aged 25–29 years, pilots/air crew, single women, and those who had completed some college or more. In contrast to all active component women, SARC use among deployers was highest among Army personnel **(Table 4)**.

The average annual prevalence of barrier-only (diaphragms or cervical caps) contraceptive use was very low (0.01%) **(data not shown)**. The extremely low prevalence precluded any attempt to identify demographic patterns of utilization. As such, no further results are presented here on the prevalence of barrier contraceptive use.

Contraceptive counseling only

During any given year of the surveillance period, an average of 4.0% of active component service women used only contraceptive counseling services as a contraceptive method **(Figure 1, Table 7)**. The average annual prevalence of the use of contraceptive counseling services only was highest among women in the youngest age group (17–19 years), those of American Indian/Alaska Native race/ethnicity, junior enlisted women, Navy or Marine Corps personnel, those in armor/motor transport or "other" occupations, single women, and those with a high school education or less. An average of 17.8% of recruit trainees used contraceptive counseling only during any given year of the surveillance period **(Table 7)**.

Among deployed women, the average annual prevalence of contraceptive counseling use only was 2.4% **(Table 4)**. Similar to the findings among all active component women, the prevalence of contraceptive counseling utilization among deployed women was highest among those in the youngest age groups (17–24 years) and among American Indians/Alaska Natives. However, among deployed women, prevalence of the use of contraceptive counseling only was higher among women in the Army and among those in combat-related occupations **(Table 4)**.

Emergency contraception

A total of 12,771 (3.7%) service women had a prescription or medical encounter for emergency contraception during the surveillance period, with an average prevalence of 1.3% per year **(Table 8)**. Emergency contraception utilization was highest among women aged 17–24 years, junior enlisted personnel, single women, and those with a high school education or less. The prevalence of emergency contraception use was similar among the service branches and among the race/ethnicity categories, although slightly higher among Hispanic women. Only 61 recruit trainees were identified as having a prescription or medical encounter for emergency contraception during the surveillance period.

A total of 163 (0.4%) deployed women had a prescription or medical encounter for emergency contraception during deployment, with an average annual prevalence of 0.4% per year **(Table 4)**. The distribution of emergency contraception utilization among deployed women was similar to that of all service women of childbearing potential.

LARC discontinuation

Among women who had an IUD inserted in 2012, 13.9% had the IUD removed within the subsequent 12 months; however, this percentage decreased to 11.2% among women who had an IUD inserted in 2015 **(Table 9)**. Among women with an IUD inserted in 2012, 21.5% and 26.6% had it removed within the next 24 and 36 months, respectively. Removal rates decreased in the following year, however, with 18.5% and 23.5% of women having had their IUD removed within the subsequent 24 and 36 months, respectively.

TABLE 3. Annual prevalence of permanent sterilization among service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016

	Average	2012		2013		2014		2015		2016	
	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	4.0	9,460	4.2	9,204	4.1	9,167	4.1	8,567	3.9	8,171	3.6
Age (years)											
17-19	0.0	1	0.0	0	0.0	3	0.0	0	0.0	1	0.0
20–24	0.2	190	0.2	141	0.2	161	0.2	95	0.1	136	0.2
25–29	1.9	1,329	2.3	1,182	2.1	1,118	2.1	840	1.5	891	1.6
30–34	6.8	2,496	7.5	2,339	6.8	2,443	7.2	2,121	6.1	2,120	6.3
35–39	14.4	3,073	15.0	3,050	14.7	3,060	14.9	3,013	13.9	2,846	13.5
40–44	16.5	1,768	15.8	1,870	16.6	1,780	17.1	1,820	16.7	1,603	16.2
45-49	13.6	603	13.7	622	13.1	602	14.0	678	13.6	574	13.7
Race/ethnicity											
Non-Hispanic white	3.5	3,861	3.7	3,729	3.6	3,671	3.6	3,297	3.4	3,202	3.3
Non-Hispanic black	5.6	3,555	6.1	3,398	5.9	3,336	5.8	3,108	5.4	2,865	5.0
Hispanic	3.5	1,136	3.6	1,144	3.5	1,207	3.6	1,232	3.5	1,217	3.2
Asian/Pacific Islander	2.9	301	3.3	290	3.1	282	3.0	257	2.7	219	2.2
American Indian/Alaska Native	3.6	107	3.8	109	4.0	98	3.7	89	3.4	78	3.1
Other	3.0	500	2.8	534	2.9	573	3.1	584	3.2	590	3.2
Grade											
Junior enlisted (E1–E4)	0.6	872	0.8	767	0.7	670	0.6	536	0.5	483	0.4
Senior enlisted (E5–E9)	8.6	7,046	9.0	6,888	8.8	6,887	8.8	6,466	8.4	6,200	8.1
Junior officer (O1–O4)	3.0	990	3.0	995	3.0	1,035	3.0	1,017	3.0	959	2.8
Senior officer (O5–O10)	7.8	325	7.9	330	7.9	345	8.4	319	7.7	296	7.2
Warrant officer (W1–W5)	14.1	227	14.1	224	13.5	230	14.2	229	14.3	233	14.6
Service											
Army	4.6	3,895	4.8	3,752	4.7	3,679	4.7	3,474	4.5	3,188	4.2
Navy	2.8	1,867	3.1	1,790	2.9	1,812	2.9	1,730	2.6	1,679	2.5
Air Force	4.9	3,348	5.0	3,314	5.0	3,342	5.1	3,068	4.9	3,029	4.7
Marine Corps	1.9	350	2.1	348	2.1	334	2.0	295	1.8	275	1.6
Military occupation											
Infantry/artillery/combat engineering	1.5	109	2.2	59	1.5	58	1.4	65	1.5	59	1.2
Armor/motor transport	3.1	243	3.6	244	3.5	215	3.0	202	2.8	183	2.6
Pilot/air crew	1.0	28	0.9	28	0.9	25	0.8	33	1.0	36	1.1
Repair/engineering	2.8	1,313	3.1	1,328	2.9	1,304	2.8	1,176	2.5	1,161	2.4
Communications/intelligence	5.5	4,250	5.5	4,191	5.6	4,141	5.6	3,914	5.4	3,718	5.1
Health care	4.7	2,017	4.8	2,013	4.8	2,040	4.9	1,921	4.7	1,836	4.5
Other	2.8	1,500	3.1	1,341	2.8	1,384	3.0	1,256	2.7	1,178	2.4
Marital status											
Married	6.2	6,600	6.6	6,450	6.4	6,436	6.4	6,061	6.0	5,899	5.8
Single	0.9	988	1.0	925	0.9	951	0.9	858	0.8	785	0.7
Other	8.7	1,872	8.6	1,829	8.8	1,780	9.0	1,648	8.8	1,487	8.2
Education											
High school or less	2.3	3,820	2.8	3,431	2.6	3,197	2.5	2,703	2.1	2,371	1.8
College/other	6.3	5,640	6.4	5,773	6.4	5,970	6.5	5,864	6.3	5,800	6.1

TABLE 4. Average annual prevalence of contraception utilization, by type, among deployed service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016

	Permanent	LARC	SARC	Counseling	Emergency
	%	%	%	%	%
Total	4.2	17.9	28.0	2.4	0.4
Age (years)					
17–19	1.3	16.8	28.7	2.9	0.4
20–24	0.6	16.8	29.8	3.6	0.5
25–29	1.3	19.0	30.6	2.4	0.5
30–34	5.0	20.2	28.9	1.9	0.5
35–39	11.4	18.2	23.7	1.6	0.2
40–44	14.7	—	20.0	1.1	—
45–49	14.6	—	—	—	—
Race/ethnicity					
Non-Hispanic white	3.4	18.3	29.3	2.0	0.3
Non-Hispanic black	5.7	17.0	27.1	2.9	0.5
Hispanic	4.0	19.6	27.0	2.5	0.7
Asian/Pacific Islander	2.6	13.6	25.6	3.7	0.7
American Indian/Alaska Native	4.5	15.4	25.1	5.0	0.6
Other	4.1	17.8	27.5	2.1	0.5
Grade					
Junior enlisted (E1–E4)	1.2	15.6	28.7	3.5	0.5
Senior enlisted (E5–E9)	6.5	20.6	25.8	2.0	0.4
Junior officer (O1–O4)	2.5	15.3	33.7	1.8	0.3
Senior officer (O5–O10)	7.2	—	—	—	0.2
Warrant officer (W1–W5)	10.0	—	—	—	—
Service					
Army	4.4	16.4	28.3	3.2	0.4
Navy	3.3	22.0	27.4	0.9	0.4
Air Force	4.3	18.7	27.6	1.4	0.4
Marine Corps	1.6	23.0	23.2	2.5	0.2
Military occupation					
Infantry/artillery/combat engineering	1.2	14.9	29.4	3.9	1.5
Armor/motor transport	5.3	17.9	25.3	2.6	0.3
Pilot/air crew	0.9	14.6	33.5	1.5	0.4
Repair/engineering	3.1	17.1	25.4	2.4	0.4
Communications/intelligence	5.1	17.9	28.7	2.7	0.5
Health care	4.3	22.8	28.4	1.3	0.4
Other	3.9	16.4	27.9	2.3	0.4
Marital status					
Married	5.5	19.1	27.1	2.3	0.3
Single	1.0	14.1	29.5	2.6	0.5
Other	6.9	22.5	27.5	2.1	0.5
Education					
High school or less	2.7	18.1	27.3	2.9	0.5
College/other	5.5	17.7	28.7	1.9	0.3

LARC, long-acting reversible contraceptive; SARC, short-acting reversible contraceptive

Implant discontinuation was more common than IUD discontinuation, with 18.4% of women who had an implant inserted in 2012 having the implant removed within the next 12 months. The percentage of women who had implants removed within 12 months of insertion increased to 28.4% among women who had implants inserted in 2015. Among women with an implant inserted in 2012, 35.5% and 52.8% had the implants removed within the next 24 and 36 months, respectively.

SARC discontinuation

The percentages of service members with more than a 30-day gap between prescriptions for oral contraceptives increased from 18.2% in 2012 to 49.4% in 2016 **(Table 10)**. The percentage of women with more than a 30-day gap between prescriptions for patches, vaginal rings, and injectables also increased during the surveillance period, from 15.6% to 35.5% for patches, 18.2% to 46.4% for vaginal rings, and 9.6% to 41.4% for injectables, respectively.

EDITORIAL COMMENT

The lack of available, population-based descriptive information on contraceptive use among U.S. service women has generated recent questions and concern about ready access to contraceptive care. The current study provides comprehensive descriptive data needed to address these questions and to examine trends in contraceptive use among U.S. service women during 2012–2016. These data demonstrate that the vast majority of service women during this period used at least one form of contraception, and that service women are using LARCs in greater numbers with each passing year. Availability of contraceptive prescriptions and procedures before and during deployment has also been highlighted as a potential gap in reproductive health services for active component women, but current results indicate that utilization during deployment has increased since the most recent study on this topic.[5]

Although these data offer a wealth of information about contraceptive use in general, a closer examination of trends in prescriptions of the various contraceptive

TABLE 5. Annual prevalence of long-acting reversible contraceptive (LARC) use among service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016

	Average	2012		2013		2014		2015		2016	
	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	19.7	38,761	17.2	41,335	18.4	43,827	19.7	47,458	21.4	48,948	21.7
Age (years)											
17–19	11.6	1,784	8.9	2,211	10.4	2,639	12.3	2,530	12.7	3,322	13.6
20–24	21.6	14,492	18.4	15,191	19.8	16,710	21.5	17,792	23.9	19,029	24.5
25–29	22.9	11,881	20.8	12,289	22.1	12,441	22.9	13,406	24.3	13,262	24.4
30–34	20.9	6,310	19.0	6,853	19.9	7,038	20.7	7,803	22.6	7,572	22.5
35–39	16.5	2,922	14.2	3,195	15.4	3,364	16.4	3,920	18.1	3,869	18.4
40–44	12.3	1,103	9.9	1,246	11.1	1,284	12.4	1,506	13.8	1,438	14.5
45–49	8.5	269	6.1	350	7.4	351	8.2	501	10.0	456	10.9
Race/ethnicity											
Non-Hispanic white	20.1	18,342	17.4	19,381	18.7	20,242	20.0	21,645	22.0	22,109	22.4
Non-Hispanic black	18.0	9,455	16.2	9,862	17.0	10,395	18.1	11,122	19.4	11,182	19.3
Hispanic	21.9	6,128	19.4	6,697	20.5	7,459	22.1	8,433	23.8	9,095	24.0
Asian/Pacific Islander	15.4	1,183	12.9	1,312	14.2	1,405	15.0	1,606	16.7	1,785	18.1
American Indian/Alaska Native	22.6	546	19.3	583	21.2	619	23.2	641	24.5	623	24.7
Other	20.1	3,107	17.2	3,500	18.8	3,707	20.0	4,011	21.8	4,154	22.5
Grade											
Junior enlisted (E1–E4)	18.7	17,210	15.9	18,432	17.3	19,487	18.7	21,950	20.9	22,613	20.9
Senior enlisted (E5–E9)	22.7	16,379	20.9	17,184	21.9	18,009	22.9	18,366	23.9	18,633	24.2
Junior officer (O1–O4)	16.6	4,546	13.7	4,995	14.8	5,541	16.3	6,276	18.5	6,765	19.8
Senior officer (O5–O10)	12.2	378	9.2	452	10.9	507	12.3	559	13.5	612	14.9
Warrant officer (W1–W5)	17.7	248	15.4	272	16.4	283	17.4	307	19.1	325	20.3
Service											
Army	16.5	12,004	14.7	12,214	15.2	12,800	16.5	13,597	17.7	13,965	18.2
Navy	22.7	11,376	18.9	12,885	21.0	13,990	22.2	16,482	25.2	17,511	26.4
Air Force	19.5	12,166	18.2	12,593	19.0	12,918	19.8	12,950	20.6	13,064	20.1
Marine Corps	23.6	3,215	19.7	3,643	22.0	4,119	24.5	4,429	26.5	4,408	25.6
Military occupation											
Infantry/artillery/combat engineering	17.9	783	15.9	640	16.4	746	18.0	862	19.4	1,006	19.8
Armor/motor transport	19.7	1,122	16.8	1,273	18.4	1,370	19.1	1,584	21.8	1,600	22.3
Pilot/air crew	19.3	498	16.4	515	16.8	583	18.5	665	21.0	759	24.0
Repair/engineering	21.4	7,704	18.3	8,994	19.9	9,791	21.2	10,978	23.5	11,534	24.2
Communications/intelligence	19.6	13,457	17.5	13,742	18.2	14,497	19.7	15,138	20.9	15,532	21.5
Health care	23.0	8,664	20.5	9,148	21.6	9,614	22.9	10,152	24.8	10,313	25.2
Other	15.5	6,533	13.3	7,023	14.6	7,226	15.6	8,079	17.2	8,204	16.8
Marital status											
Married	22.0	20,753	20.6	21,335	21.3	22,152	21.9	22,969	22.9	23,615	23.2
Single	16.6	13,303	12.9	15,186	14.6	16,851	16.6	19,684	19.2	20,592	19.6
Other	24.2	4,705	21.6	4,814	23.1	4,824	24.3	4,805	25.7	4,741	26.2
Education											
High school or less	20.9	25,081	18.3	26,173	19.5	27,347	20.9	29,336	22.8	29,701	22.9
College/other	17.9	13,680	15.5	15,162	16.7	16,480	17.9	18,122	19.4	19,247	20.2
Recruit[a]											
Yes	3.7	841	3.1	1,032	3.5	710	2.7	1,509	5.3	1,148	3.9

[a]Percentage of women who had a LARC encounter or prescription during period of recruit training, among the total number of female recruits who served that year

TABLE 6. Annual prevalence of short-acting reversible contraceptive (SARC) use among service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016

	Average	2012		2013		2014		2015		2016	
	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	34.5	86,674	38.5	82,080	36.5	78,127	35.1	71,158	32.1	68,401	30.4
Age (years)											
17–19	44.6	10,544	52.6	9,930	46.5	9,771	45.5	8,792	44.2	8,346	34.2
20–24	38.2	34,126	43.4	31,340	40.8	29,809	38.4	27,096	36.4	25,010	32.2
25–29	35.8	22,814	40.0	21,329	38.3	19,825	36.5	17,956	32.5	17,243	31.7
30–34	31.4	10,981	33.0	11,157	32.4	10,980	32.3	10,092	29.2	10,090	30.0
35–39	24.8	5,339	26.0	5,435	26.2	5,121	24.9	4,847	22.4	5,172	24.6
40–44	19.4	2,278	20.4	2,247	20.0	2,028	19.5	1,862	17.0	1,973	19.9
45–49	12.9	592	13.5	642	13.5	593	13.8	513	10.3	567	13.5
Race/ethnicity											
Non-Hispanic white	36.2	42,476	40.4	39,718	38.3	37,258	36.9	33,371	33.9	31,153	31.6
Non-Hispanic black	32.2	20,585	35.3	19,368	33.5	18,700	32.6	17,242	30.1	16,946	29.3
Hispanic	33.0	11,748	37.2	11,528	35.2	11,302	33.4	10,639	30.0	11,023	29.0
Asian/Pacific Islander	32.0	3,307	36.0	3,105	33.5	3,050	32.7	2,847	29.5	2,796	28.3
American Indian/Alaska Native	32.9	1,078	38.1	982	35.7	861	32.2	787	30.1	723	28.6
Other	36.8	7,480	41.4	7,379	39.7	6,956	37.5	6,272	34.1	5,760	31.3
Grade											
Junior enlisted (E1–E4)	37.4	45,716	42.3	42,777	40.1	40,007	38.4	35,989	34.2	34,862	32.2
Senior enlisted (E5–E9)	28.7	24,354	31.1	23,283	29.6	22,686	28.8	21,012	27.4	20,507	26.6
Junior officer (O1–O4)	40.6	15,092	45.6	14,604	43.4	14,100	41.4	12,866	37.9	11,836	34.6
Senior officer (O5–O10)	22.4	1,017	24.7	971	23.3	920	22.3	895	21.7	827	20.2
Warrant officer (W1–W5)	26.1	495	30.7	445	26.8	414	25.5	396	24.7	369	23.1
Service											
Army	31.2	28,710	35.1	26,102	32.4	24,472	31.6	22,229	29.0	21,517	28.1
Navy	36.2	24,871	41.4	24,170	39.3	23,548	37.3	21,387	32.7	20,224	30.5
Air Force	37.1	26,689	39.9	25,734	38.8	24,663	37.8	22,574	35.9	21,582	33.2
Marine Corps	33.5	6,404	39.2	6,074	36.7	5,444	32.3	4,968	29.7	5,078	29.5
Military occupation											
Infantry/artillery/combat engineering	33.8	1,837	37.3	1,556	39.7	1,381	33.3	1,357	30.5	1,442	28.4
Armor/motor transport	34.5	2,650	39.7	2,484	35.9	2,512	34.9	2,316	31.9	2,172	30.3
Pilot/air crew	43.1	1,457	47.8	1,424	46.5	1,373	43.6	1,256	39.7	1,196	37.8
Repair/engineering	31.9	15,239	36.2	14,908	32.9	14,999	32.4	13,927	29.8	13,437	28.2
Communications/intelligence	33.3	28,313	36.7	26,287	34.9	24,660	33.5	22,641	31.3	21,619	29.9
Health care	34.7	15,856	37.6	15,397	36.4	15,007	35.7	13,543	33.1	12,671	30.9
Other	38.2	21,322	43.4	20,024	41.7	18,195	39.2	16,118	34.4	15,864	32.4
Marital status											
Married	30.0	33,323	33.1	31,562	31.5	30,818	30.4	28,293	28.2	27,427	26.9
Single	39.4	45,803	44.5	43,671	42.1	41,031	40.4	37,187	36.2	35,661	33.9
Other	31.8	7,548	34.7	6,847	32.9	6,278	31.7	5,678	30.4	5,313	29.3
Education											
High school or less	35.1	54,788	40.0	49,634	37.0	46,508	35.6	41,521	32.3	39,902	30.7
College/other	33.6	31,886	36.2	32,446	35.7	31,619	34.3	29,637	31.8	28,499	29.9
Recruit[a]											
Yes	12.1	4,456	16.2	4,082	13.8	3,535	13.4	2,540	8.9	2,394	8.1

[a]Percentage of women who had a SARC encounter or prescription during period of recruit training, among the total number of female recruits who served that year

TABLE 7. Annual prevalence of use of contraceptive counseling services only among service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016

	Average	2012		2013		2014		2015		2016	
	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	4.0	8,663	3.9	9,432	4.2	9,143	4.1	9,768	4.4	7,994	3.6
Age (years)											
17–19	15.9	3,099	15.5	3,385	15.8	3,391	15.8	3,665	18.4	3,383	13.9
20–24	4.3	3,165	4.0	3,453	4.5	3,380	4.4	3,700	5.0	2,916	3.8
25–29	2.4	1,333	2.3	1,405	2.5	1,330	2.5	1,375	2.5	1,062	2.0
30–34	1.8	647	1.9	729	2.1	647	1.9	659	1.9	386	1.2
35–39	1.3	299	1.5	314	1.5	285	1.4	259	1.2	191	0.9
40–44	0.8	98	0.9	123	1.1	94	0.9	90	0.8	42	0.4
45–49	0.4	22	0.5	23	0.5	16	0.4	20	0.4	14	0.3
Race/ethnicity											
Non-Hispanic white	3.5	3,366	3.2	3,801	3.7	3,670	3.6	3,904	4.0	3,214	3.3
Non-Hispanic black	4.0	2,215	3.8	2,464	4.3	2,334	4.1	2,524	4.4	1,950	3.4
Hispanic	4.9	1,556	4.9	1,618	4.9	1,740	5.1	1,874	5.3	1,617	4.3
Asian/Pacific Islander	4.8	369	4.0	409	4.4	476	5.1	545	5.7	459	4.7
American Indian/Alaska Native	5.2	170	6.0	146	5.3	143	5.4	140	5.4	97	3.8
Other	4.6	987	5.5	994	5.4	780	4.2	781	4.3	657	3.6
Grade											
Junior enlisted (E1–E4)	6.9	6,863	6.4	7,523	7.0	7,385	7.1	8,008	7.6	6,878	6.4
Senior enlisted (E5–E9)	1.5	1,272	1.6	1,319	1.7	1,209	1.5	1,178	1.5	698	0.9
Junior officer (O1–O4)	1.4	468	1.4	553	1.6	500	1.5	525	1.6	391	1.1
Senior officer (O5–O10)	0.6	32	0.8	21	0.5	22	0.5	34	0.8	15	0.4
Warrant officer (W1–W5)	1.3	28	1.7	16	1.0	27	1.7	23	1.4	12	0.8
Service											
Army	2.1	1,844	2.3	1,829	2.3	1,752	2.3	1,771	2.3	1,046	1.4
Navy	7.4	4,287	7.1	4,852	7.9	4,700	7.5	5,188	7.9	4,415	6.7
Air Force	1.5	1,128	1.7	1,130	1.7	945	1.5	1,084	1.7	649	1.0
Marine Corps	10.0	1,404	8.6	1,621	9.8	1,746	10.4	1,725	10.3	1,884	10.9
Military occupation											
Infantry/artillery/combat engineering	1.7	77	1.6	74	1.9	78	1.9	87	2.0	68	1.3
Armor/motor transport	10.3	575	8.6	679	9.8	753	10.5	889	12.2	750	10.5
Pilot/air crew	1.5	40	1.3	54	1.8	49	1.6	50	1.6	33	1.0
Repair/engineering	2.8	1,225	2.9	1,308	2.9	1,295	2.8	1,437	3.1	1,148	2.4
Communications/intelligence	2.0	1,645	2.1	1,667	2.2	1,456	2.0	1,527	2.1	970	1.3
Health care	1.4	642	1.5	680	1.6	627	1.5	638	1.6	432	1.1
Other	10.1	4,459	9.1	4,970	10.3	4,885	10.5	5,140	11.0	4,593	9.4
Marital status											
Married	2.1	2,200	2.2	2,264	2.3	2,236	2.2	2,353	2.3	1,644	1.6
Single	6.4	6,125	6.0	6,782	6.5	6,600	6.5	7,130	6.9	6,183	5.9
Other	1.5	338	1.6	386	1.9	307	1.6	285	1.5	167	0.9
Education											
High school or less	5.5	6,934	5.1	7,513	5.6	7,263	5.6	7,822	6.1	6,628	5.1
College/other	1.9	1,729	2.0	1,919	2.1	1,880	2.0	1,946	2.1	1,366	1.4
Recruit[a]											
Yes	17.8	4,529	16.5	5,103	17.3	5,115	19.4	5,507	19.2	4,822	16.4

[a]Percentage of women who had a contraceptive counseling encounter during period of recruit training, among the total number of female recruits who served that year

TABLE 8. Annual prevalence of emergency contraception utilization among service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016

	Average	2012		2013		2014		2015		2016	
	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	1.3	969	0.4	2,404	1.1	3,768	1.7	3,506	1.6	4,367	1.9
Age (years)											
17–19	1.9	139	0.7	277	1.3	569	2.7	481	2.4	636	2.6
20–24	2.0	517	0.7	1,234	1.6	1,893	2.4	1,765	2.4	2,117	2.7
25–29	1.3	238	0.4	629	1.1	869	1.6	850	1.5	1,072	2.0
30–34	0.8	55	0.2	200	0.6	332	1.0	310	0.9	381	1.1
35–39	0.3	15	0.1	53	0.3	78	0.4	84	0.4	131	0.6
40–44	0.1	4	0.0	9	0.1	25	0.2	15	0.1	25	0.2
45–49	0.0	1	0.0	2	0.0	2	0.1	1	0.0	5	0.1
Race/ethnicity											
Non-Hispanic white	1.0	386	0.4	828	0.8	1,263	1.3	1,079	1.1	1,279	1.3
Non-Hispanic black	1.6	253	0.4	723	1.3	1,147	2.0	1,174	2.1	1,431	2.4
Hispanic	1.9	184	0.6	497	1.5	834	2.5	769	2.2	1,019	2.7
Asian/Pacific Islander	1.6	42	0.5	113	1.2	185	2.0	187	1.9	225	2.3
American Indian/Alaska Native	1.3	13	0.5	34	1.2	44	1.7	30	1.2	46	1.8
Other	1.3	91	0.5	209	1.1	295	1.6	267	1.5	367	2.0
Grade											
Junior enlisted (E1–E4)	2.0	726	0.7	1,651	1.6	2,613	2.5	2,427	2.3	2,997	2.8
Senior enlisted (E5–E9)	0.9	185	0.2	581	0.7	896	1.1	849	1.1	1,096	1.4
Junior officer (O1–O4)	0.6	56	0.2	163	0.5	252	0.7	217	0.6	258	0.8
Senior officer (O5–O10)	0.0	1	0.0	.	.	1	0.0	3	0.1	3	0.1
Warrant officer (W1–W5)	0.5	1	0.1	9	0.5	6	0.4	10	0.6	13	0.8
Service											
Army	1.5	369	0.5	982	1.2	1,490	1.9	1,389	1.8	1,641	2.1
Navy	1.4	255	0.4	716	1.2	1,164	1.8	1,091	1.7	1,410	2.1
Air Force	1.0	306	0.5	517	0.8	755	1.2	680	1.1	879	1.3
Marine Corps	1.6	39	0.2	189	1.1	359	2.1	346	2.1	437	2.5
Military occupation											
Infantry/artillery/combat engineering	1.3	15	0.3	33	0.8	80	1.9	71	1.6	84	1.7
Armor/motor transport	1.6	33	0.5	82	1.2	149	2.1	139	1.9	180	2.5
Pilot/air crew	0.7	6	0.2	18	0.6	24	0.8	25	0.8	35	1.1
Repair/engineering	1.4	214	0.5	481	1.1	819	1.8	743	1.6	929	1.9
Communications/intelligence	1.4	319	0.4	810	1.1	1,233	1.7	1,212	1.7	1,477	2.0
Health care	1.4	176	0.4	505	1.2	753	1.8	649	1.6	784	1.9
Other	1.2	206	0.4	475	1.0	710	1.5	667	1.4	878	1.8
Marital status											
Married	0.8	256	0.3	673	0.7	1,045	1.0	1,008	1.0	1,297	1.3
Single	1.8	621	0.6	1,509	1.5	2,411	2.4	2,209	2.2	2,716	2.6
Other	1.3	92	0.4	222	1.1	312	1.6	289	1.6	354	1.9
Education											
High school or less	1.8	758	0.6	1,820	1.4	2,924	2.2	2,666	2.1	3,306	2.5
College/other	0.8	211	0.2	584	0.6	844	0.9	840	0.9	1,061	1.1
Recruit[a]											
Yes	0.1	.	.	14	0.0	32	0.1	13	0.0	2	0.0

[a]Percentage of women who had an emergency contraception encounter during period of recruit training, among the total number of female recruits who served that year

TABLE 9. Long-acting reversible contraceptive (LARC) discontinuation among service women with LARC insertion, active component, U.S. Armed Forces, 2012–2016

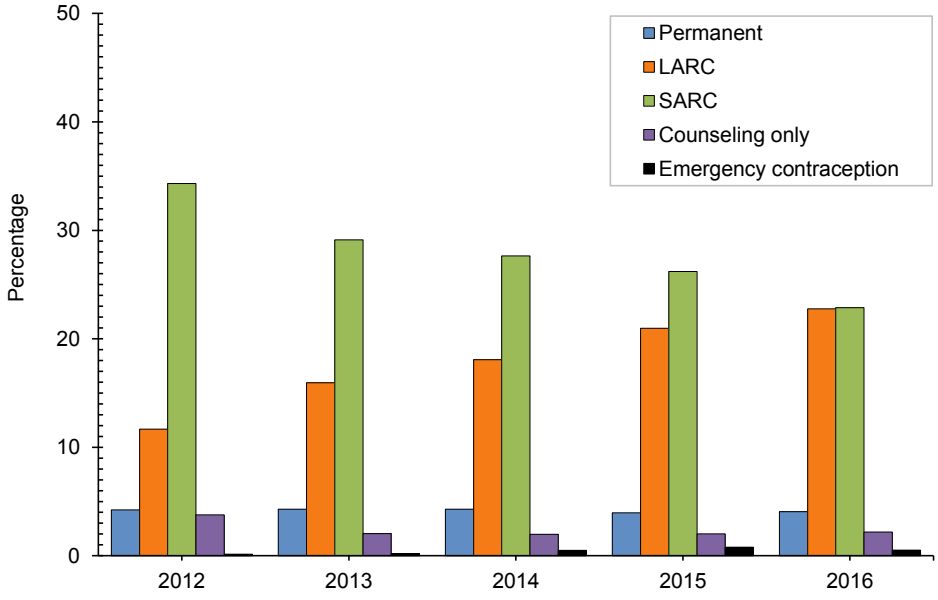
	Discontinuation at less than or equal to 12 months						Discontinuation at less than or equal to 24 months						Discontinuation at less than or equal to 36 months					
	IUD			Implant			IUD			Implant			IUD			Implant		
Insertion year	No.	Total	%	No.	Total	%	No.	Total	%	No.	Total	%	No.	Total	%	No.	Total	%
2012	1,928	13,859	13.9	97	527	18.4	2,983	13,859	21.5	187	527	35.5	3,692	13,859	26.6	278	527	52.8
2013	1,429	12,543	11.4	110	575	19.1	2,315	12,543	18.5	214	575	37.2	2,942	12,543	23.5	341	575	59.3
2014	1,293	12,115	10.7	159	600	26.5	2,211	12,115	18.3	288	600	48.0	-	-	-	-	-	-
2015	1,132	10,085	11.2	129	454	28.4	-	-	-	-	-	-	-	-	-	-	-	-

IUD, intrauterine device

TABLE 10. Short-acting reversible contraceptive (SARC) discontinuation among service women with SARC insertion, active component, U.S. Armed Forces, 2012–2016

	Oral contraceptive			Patch			Vaginal ring			Injectable		
Year	No.	Total	%	No.	Total	%	No.	Total	%	No.	Total	%
2012	13,005	71,410	18.2	892	5,719	15.6	2,539	13,963	18.2	983	10,265	9.6
2013	27,267	68,510	39.8	1,618	5,410	29.9	4,750	12,419	38.3	2,574	10,423	24.7
2014	30,238	66,210	45.7	1,711	5,099	33.6	4,883	11,083	44.1	3,045	10,219	29.8
2015	32,240	60,326	53.4	1,752	4,311	40.6	4,564	9,090	50.2	3,623	9,973	36.3
2016	30,056	60,884	49.4	1,470	4,144	35.5	3,763	8,110	46.4	4,202	10,149	41.4

FIGURE 2. Annual prevalence of contraceptive utilization during deployment, by type, service women of childbearing potential, active component, U.S. Armed Forces, 2012–2016



LARC, long-acting reversible contraceptive; SARC, short-acting reversible contraceptive

methods provides a view of changes in prescribing patterns within the MHS. As in civilian populations, efforts have been underway within the MHS to ensure that women have access to the full range of contraceptive options, including LARCs. The notable rise in LARC prescriptions, from 17.2% to 21.7% over the 5-year period, may demonstrate the impact of these efforts and also mirror trends occurring in the U.S. population overall. Education programs about contraceptive and non-contraceptive benefits of LARCs as well as other programs such as walk-in contraceptive clinics may have contributed to the rise in LARC use.

Although the increase in LARC use can be construed as a positive trend, the concomitant notable decline in SARC prescriptions and modest reduction in contraceptive use overall demands attention. The decrease in SARCs from 38.5% in 2012 to 30.4% in 2016 was not completely offset by the increase in

LARCs and was likely the principal component of the decrease in total contraceptive utilization. Additionally, the average annual prevalence of SARCs was 28.0% among deployed women during the surveillance period, which is a marked decrease from the previously reported prevalence.[5] There is no ideal number for LARC versus SARC, but it is critical that SARCs remain an option, as contraception is a personal choice and SARCs may offer desirable benefits to individual women. Although the prevalence of SARC use decreased during the surveillance period, it was still higher than previous population- and survey-based estimates.[5,8]

Another notable contribution to the literature from these data is information about contraceptive continuation rates among active duty service women. The previous population-based study of prescriptions and procedures among service women did not include data on removal of LARCs.[5] The current study used ICD-9/ICD-10 codes and pharmacy data to estimate the length of continuation of LARCs and demonstrated that 86.1% of women continued using their IUD at 12 months after insertion, 78.5% at 24 months, and 73.4% at 36 months. On average, women requested removal of implants earlier than IUDs; among women who had an implant inserted in 2012, 81.6% of women continued at 12 months and only 64.5% continued use at 24 months.

These data reveal that continuation rates of LARCs are similar to those seen in the general U.S. population and among MHS beneficiaries in general. The large prospective Contraceptive CHOICE Project (CHOICE), which examined the contraceptive choices and practices of women in the St. Louis region who were offered contraception at no cost for 3 years, followed women for 2–3 years and were able to estimate 3-year continuation rates of contraceptive methods that were chosen at enrollment.[9] They found that 36-month continuation rates were about 70% for both types of IUDs and 56% for implant users.[9] Chiles et al. recently examined initiation and continuation of LARC use among all female beneficiaries of the MHS.[10] Among women who selected IUDs, 61.2% continued use of that method at 36 months and 48.8% continued use at 60 months. In multivariable analyses, early discontinuation of either method (IUDs or implants) was more common among women aged 20–24 years and implant users.[10] Women with implants discontinued at a higher rate, which is also the trend seen in the current study.

In this study, the increasing proportion of women who discontinued use of SARCs during the surveillance period likely reflects the decrease in SARC use overall. Although it is possible that women who discontinued SARCs may have shifted to LARCs for their contraceptive needs, there may be other reasons for discontinuing their selected contraceptive method, including difficulty in obtaining refills and in renewing prescriptions or other obstacles to continuing their desired method during deployment.

Some methodologic limitations should be considered in interpreting the results of the current study. First, estimated rates reported in this analysis may underestimate contraceptive utilization because they include only contraceptive methods purchased by the MHS or coded in the military's electronic health records. Not captured in this analysis are contraceptives obtained elsewhere (e.g., purchased over the counter or out of pocket by the service member, provided at no cost at health fairs or in other venues, or prescribed by civilian medical providers who are not reimbursed by the MHS). Second, incorrect or nonspecific days' supply information may have led to inaccurate estimates of the coverage periods for contraceptives. In addition, prescription data may overestimate actual utilization of SARCs if women fail to initiate or maintain use. The estimation of discontinuation by identifying women with more than a 30-day gap between prescriptions for SARCs should mitigate overestimates of SARC use but does not identify women who may refill prescriptions but then not take the pills. It is also possible that a LARC was removed in a location that was not captured in the administrative data. In particular, LARC continuation calculations assumed that women who left military service during the 12, 24, and 36 months following LARC insertion did not have their LARC removed during this period.

The analyses presented here provide insight into the evolving trends in contraceptive use among U.S. service women within the MHS. Future analyses hold the promise of providing additional information about potential impediments, facilitators, and health outcomes associated with specific contraceptive methods to enhance service women's readiness and ability to complete their missions.

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Complications and Care Related to Pregnancy, Labor, and Delivery Among Active Component Service Women, U.S. Armed Forces, 2012–2016

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Diagnoses of "complications of pregnancy, childbirth, and the puerperium" include both morbid complications and indications for routine care of pregnant women. During 2012–2016, a total of 55,601 U.S. service members with live births (n=63,879) had 657,060 medical encounters with primary diagnoses of "pregnancy complications." The most frequent diagnoses were "other" specified conditions complicating pregnancy, childbirth, or the puerperium. Numbers of medical encounters with a primary (first-listed) diagnosis of any pregnancy-related complication or indication for care decreased marginally each year between 2012 (n=178,703) and 2016 (n=146,282). The percentage of live births affected by pre-eclampsia and gestational diabetes remained relatively stable during the surveillance period. For all age groups, percentages of live births affected by preterm labor decreased, but live births affected by obesity complications increased. The percentage of live births affected by gestational diabetes was more than twice as high for obese women, compared with non-obese women (12.4% vs. 5.5%). Findings suggest some opportunities to prevent sequelae for the mother and child and to mitigate longer-term impacts on force readiness.

Labor and delivery has historically been one of the leading reasons for hospitalization of active component service women in the U.S. Armed Forces. In 2016, pregnancy- and delivery-related diagnoses were the second most frequent cause of hospitalization, accounting for more than one-fifth (22.3%) of all hospitalizations in female service members and more than 15% of bed days (15.5%; 54,856 bed days) overall.[1,2]

Some published reviews of reproductive health outcomes in female service members have suggested that service women may have a higher prevalence of pregnancy complications and preterm labor than their civilian counterparts.[3,4] However, most of the published studies in these reviews have been small and/or service-specific, making population-level comparisons between U.S. military and civilian women problematic.

Diagnoses indicating pregnancy complications are common in civilian discharge data. For example, of the 4.2 million deliveries in U.S. civilian women in 2008, more than 94% had at least one pregnancy complication listed as a discharge diagnosis.[5] Recent data from the Centers for Disease Control and Prevention (CDC) indicate that the rates of some more serious pregnancy complications, such as hypertension disorders of pregnancy (e.g., preeclampsia, gestational hypertension) and gestational diabetes, have increased over the past several years.[6,7]

In 2011, the *MSMR* published a surveillance report summarizing diagnoses that represented complications of pregnancy and delivery during the previous decade (i.e., 2001–2010) to investigate observed increases in the number of medical encounters falling into this class of diagnoses. Complications and indications for care related to pregnancy and delivery were identified through ICD-9 codes 640.0–679.1. These diagnostic codes represent both routine care and morbid conditions related to pregnancy and delivery. The analysis included more than 1 million medical encounters (n=1,160,000) with a pregnancy or delivery complication diagnosis and noted that the vast majority of encounters were for routine care or "other conditions in pregnancy" representing common current conditions during pregnancies (e.g., headache, back pain). The specific diagnoses contributing to the greatest increase in pregnancy- and delivery-related medical encounters included previous cesarean delivery, elderly primagravida, and gestational diabetes.[8]

This analysis updates the previous *MSMR* report on pregnancy complications. The prior report (which primarily summarized ICD-9 diagnoses) has been enhanced through the addition of more extensive data characterizing the counts, rates, and trends of several specific pregnancy complications (e.g., preterm labor, gestational diabetes).

METHODS

The surveillance population consisted of all active component female service members of childbearing potential who had a hospitalization for live birth delivery during 2012–2016. Women of childbearing potential were defined as women aged 17–49 years with no prior history of hysterectomy.[9] Live birth deliveries were defined by an inpatient record with ICD-9 V27.* or ICD-10 Z37.* in any diagnostic position. Encounters for deliveries that resulted in only still births (ICD-9: V27.1, V27.4, V27.7; ICD-10: Z37.1, Z37.4, Z37.7) were excluded. An individual was eligible to be counted as having a new live birth once every 280 days.

Endpoints of analyses were complications and indications for care related to pregnancy, labor, and delivery, as defined by four-digit ICD-9 diagnosis codes 640.0–679.1 and ICD-10 diagnosis codes O09.4–O09.5, O10–O77, O80, O82, O85–O92, O94–O99, O9A. These "indicator diagnoses" were reported during hospitalizations or ambulatory visits in U.S. military and civilian (reimbursed care) medical treatment facilities within 280 days before to 7 days after each delivery hospitalization during the surveillance period. If, for example, a live birth delivery took place in January 2012, diagnoses dating back to April 2011 were included for that delivery in the analysis.

The primary summary measures used for analyses were numbers of "medical encounters" for and "live births affected" by each four-digit level coded diagnosis of complications or care. Numbers of medical encounters of interest were the numbers of inpatient or outpatient visits with indicator diagnoses in the primary (first-listed) diagnostic position. Live births affected were the number of pregnancies or deliveries during which an indicator diagnosis was recorded in any diagnostic position. The percentage of live births affected was calculated as the number of live births affected by the given four-digit ICD code divided by the total number of live births during the surveillance period.

Pre-eclampsia (ICD-9: 642.4*, 642.5*; ICD-10: O14.0*, O14.1*, O14.9*); preterm labor (ICD-9: 644.0*, 644.2*; ICD-10: O60.*); obesity complicating pregnancy, childbirth, or the puerperium (ICD-9: 649.1*; ICD-10: O99.21*); and gestational diabetes were analyzed separately in this report.

Gestational diabetes was defined as one hospitalization or outpatient medical encounter with a defining diagnosis for gestational diabetes mellitus (ICD-9: 648.0*; ICD-10: O24.4*, O24.91*, O24.92, O24.93) in any diagnostic position; or, one hospitalization with a diagnosis of abnormal glucose tolerance (ICD-9: 648.80*; ICD-10: O99.81*) in any diagnostic position; or, two or more outpatient medical encounters, at least 7 days apart, with a diagnosis of abnormal glucose tolerance in any diagnostic position. Cases were required to occur in the interval between 280 days before and 7 days after a hospitalization for live birth delivery (as previously specified). Women with any prior diagnosis of diabetes mellitus during an inpatient or outpatient medical encounter were excluded from the gestational diabetes analysis. Women were categorized as obese if they had a diagnosis for obesity (ICD-9: 278.0, 278.00, 278.01, 278.03, V85.3*, V85.4*, V85.54; ICD-10: E66.01, E66.09, E66.1, E66.2, E66.8, E66.9, Z68.3*, Z68.4*) in any diagnostic position during an outpatient medical encounter prior to the live birth delivery.

RESULTS

From 1 January 2012 through 31 December 2016, there were 63,879 deliveries resulting in live births among 55,601 active component service members.[9] The majority of women who contributed these live births had their first- (65.3%) or second-ever (26.7%) live birth deliveries and a smaller percentage had their third (6.5%), fourth (1.2%), or fifth or more (0.26%) live births **(data not shown)**. The 63,879 live births were associated with 587,694 outpatient visits (89.4% of all encounters) and 69,366 inpatient stays (10.6% of all encounters) during which complications and indications for care were diagnosed **(data not shown)**. Of the 255 different four-digit level ICD-9 coded indicator diagnoses identified, the majority of such diagnoses (54.1%) affected less than 0.5% each of all live births during the surveillance period **(data not shown)**. Similarly, of the 340 four-digit level ICD-10-coded diagnoses identified, 77.9% affected less than 0.5% each of all live births **(data not shown)**.

Complications and indicators for care associated with the most medical encounters

From 1 January 2012 through 30 September 2015, the four most frequent indicator diagnoses identified using ICD-9 codes (at the four-digit level) accounted for one-quarter (25.2%) of all indicator medical encounters. The 13 most frequent indicator diagnoses accounted for approximately half of all indicator medical encounters **(Table 1)**. Similarly, from 1 October 2015 through 31 December 2016, the four most frequent indicator diagnoses identified using ICD-10 codes (at the four-digit level) accounted for one-quarter (25.4%), and the 14 most frequent accounted for slightly more than half (51.0%) of all indicator medical encounters **(Table 2)**. In ICD-9, the most frequently coded diagnosis was "other specified complications of pregnancy" (646.8) **(Table 1)**. In ICD-10, the most frequently coded diagnosis was "other specified diseases and conditions complicating pregnancy, childbirth, and the puerperium" (O99.8) **(Table 2)**.

The second through fourth most frequent indicators in ICD-9 were "other current conditions complicating pregnancy, childbirth, or the puerperium" (648.9), "unspecified complications of pregnancy" (646.9), and "previous cesarean delivery complicating pregnancy, childbirth, or the puerperium" (654.2) **(Table 1)**. In ICD-10, the second through fourth most frequent indicators were "other specified pregnancy-related conditions" (O26.8), "supervision of elderly primigravida and multigravida" (O09.5), and "maternal care due to uterine scar from previous surgery" (O34.2) **(Table 2)**.

The most common diagnoses co-occurring with the three most frequent nonspecific four-digit ICD-9 codes (646.8, 648.9, and 646.9) were V02.51 "carrier or suspected carrier of group B streptococcus" (6.1% of encounters), 789.00 "unspecified abdominal pain" (5.7% of encounters), and 784.0 "headache" (3.6% of encounters) **(data not shown)**. Of the two most frequent nonspecific four-digit codes in ICD-10 (O99.8 and O26.8), the most common co-occurring diagnoses were R10.9 "unspecified abdominal pain" (6.4% of encounters), low back pain (M54.5; 6.1% of encounters), and O998.24 "streptococcus B carrier state complicating pregnancy" (4.9% of encounters) **(data not shown)**.

Complications and care that affected the most live births

All but one of the live births during the surveillance period was associated with one or more coded diagnoses of a complication or indication for care. The three ICD-9 diagnoses that affected the most live births (24.0%–45.9% of pregnancies

TABLE 1. Number of ICD-9 medical encounters[a] for and live births affected[b] by "pregnancy complications" among service women, active component, U.S. Armed Forces, 1 January 2012 through 30 September 2015

ICD-9 code	Description	No. encounters[a]	Rank	% of all encounters	No. live births affected[b]	Rank	% live births affected
646.8	Other specified complications of pregnancy	52,188	1	8.3	24,744	2	38.7
648.9	Other current conditions complicating pregnancy, childbirth, or the puerperium	41,032	2	6.6	29,310	1	45.9
646.9	Unspecified complication of pregnancy	33,980	3	5.4	15,316	3	24.0
654.2	Previous cesarean delivery complicating pregnancy, childbirth, or the puerperium	30,423	4	4.9	6,165	19	9.7
648.8	Abnormal glucose tolerance of mother complicating pregnancy, childbirth, or the puerperium	26,685	5	4.3	5,937	20	9.3
659.6	Elderly multigravida	20,005	6	3.2	4,601	26	7.2
659.9	Unspecified indication for care or intervention related to labor or delivery	19,469	7	3.1	11,182	9	17.5
646.1	Edema or excessive weight gain in pregnancy without mention of hypertension	18,036	8	2.9	9,249	15	14.5
644.0	Threatened premature labor	15,574	9	2.5	8,048	17	12.6
644.1	Other threatened labor	15,024	10	2.4	11,282	8	17.7
648.7	Bone and joint disorders of back pelvis and lower limbs of mother complicating pregnancy childbirth or the puerperium	14,830	11	2.4	10,062	13	15.8
648.2	Anemia complicating pregnancy, childbirth, or the puerperium	14,738	12	2.4	10,442	11	16.3
650	Normal delivery	14,057	13	2.2	11,691	6	18.3
645.1	Post-term pregnancy	13,414	14	2.1	11,562	7	18.1
646.6	Infections of genitourinary tract in pregnancy	12,638	15	2.0	10,795	10	16.9
640.0	Threatened abortion	12,636	16	2.0	8,699	16	13.6
664.0	First-degree perineal laceration during delivery	11,388	17	1.8	11,767	5	18.4
651.0	Twin pregnancy	10,337	18	1.7	954	79	1.5
664.1	Second-degree perineal laceration during delivery	10,038	19	1.6	10,108	12	15.8
642.0	Benign essential hypertension complicating pregnancy, childbirth, and the puerperium	8,934	20	1.4	2,047	48	3.2
659.7	Abnormality in fetal heart rate or rhythm	8,845	21	1.4	12,369	4	19.4
642.9	Unspecified hypertension complicating pregnancy, childbirth, or the puerperium	8,725	22	1.4	3,440	34	5.4
648.4	Mental disorders complicating pregnancy, childbirth, or the puerperium	8,417	23	1.3	4,791	25	7.5
642.3	Transient hypertension of pregnancy	8,300	24	1.3	4,924	24	7.7
656.5	Poor fetal growth affecting management of mother	8,118	25	1.3	3,544	33	5.5

[a]Inpatient or outpatient encounters with a primary (first-listed) diagnosis

[b]Inpatient or outpatient encounters during which an indicator diagnosis was recorded in any diagnostic position

during the period) were the same as the three leading causes of medical encounters. "Abnormality in fetal heart rate or rhythm" (ICD-9: 659.7) was ranked fourth, affecting 19.4% of live births **(Table 1)**. In ICD-10, the two diagnoses associated with the most live births (9.9%–12.3% of pregnancies) were the same as the leading causes of medical encounters (O99.8 and O26.8), but the third leading cause of live births affected was "abnormality in fetal heart rate and rhythm complicating labor and delivery" (ICD-10: O76) **(Table 2)**. "First-degree perineal laceration during delivery" (ICD-9: 664.0; ICD-10: O70.0) was ranked fourth in ICD-10 and fifth in ICD-9 for live births affected. In terms of the number of live births affected, "normal delivery" (ICD-9: 650; ICD-10: O80) was ranked fifth and sixth for ICD-10 and ICD-9, respectively.

Trends in complication- or care-related medical encounters

Numbers of medical encounters with a primary (first-listed) diagnosis of any pregnancy-related complication or indication for care decreased slightly each year between 2012 (n=178,703) and 2016 (n=146,282) **(Figure 1)**. Decreases in the numbers of encounters occurred primarily

TABLE 2. Number of ICD-10 medical encountersa for and live births affected by "pregnancy complications" among service women, active component, U.S. Armed Forces, 1 October 2015 through 31 December 2016

ICD-10 code	Description	No. encounters[a]	Rank	% of all encounters	No. live births affected[b]	Rank	% live births affected
O99.8	Other specified diseases and conditions complicating pregnancy, childbirth, and the puerperium	13,006	1	8.8	7,837	1	12.3
O26.8	Other specified pregnancy-related conditions	10,117	2	6.8	6,297	2	9.9
O09.5	Supervision of elderly primigravida and multigravida	7,855	3	5.3	1,507	19	2.4
O34.2	Maternal care due to uterine scar from previous surgery	6,739	4	4.5	1,692	16	2.6
O24.4	Gestational diabetes mellitus	5,570	5	3.8	950	31	1.5
O48.0	Post-term pregnancy	4,642	6	3.1	3,366	6	5.3
O80	Encounter for full-term uncomplicated delivery	4,424	7	3.0	3,540	5	5.5
O26.0	Excessive weight gain in pregnancy	3,844	8	2.6	2,471	10	3.9
O99.2	Endocrine, nutritional and metabolic diseases complicating pregnancy, childbirth, and the puerperium	3,692	9	2.5	2,185	14	3.4
O99.0	Anemia complicating pregnancy, childbirth, and the puerperium	3,361	10	2.3	2,505	9	3.9
O75.8	Other specified complications of labor and delivery	3,225	11	2.2	2,418	11	3.8
O70.0	First-degree perineal laceration during delivery	3,143	12	2.1	3,596	4	5.6
O70.1	Second-degree perineal laceration during delivery	3,090	13	2.1	3,210	8	5.0
O30.0	Twin pregnancy	3,034	14	2.0	263	85	0.4
O13.3	Gestational [pregnancy-induced] hypertension without significant proteinuria, third trimester	2,998	15	2.0	1,499	20	2.3
O47.1	False labor at or after 37 completed weeks of gestation	2,877	16	1.9	2,342	12	3.7
O76	Abnormality in fetal heart rate and rhythm complicating labor and delivery	2,871	17	1.9	3,778	3	5.9
O36.5	Maternal care for known or suspected poor fetal growth	2,650	18	1.8	895	35	1.4
O99.3	Mental disorders and diseases of the nervous system complicating pregnancy, childbirth, and the puerperium	2,509	19	1.7	1,867	15	2.9
O36.8	Maternal care for other specified fetal problems	2,461	20	1.7	2,202	13	3.4
O10.0	Pre-existing essential hypertension complicating pregnancy, childbirth, and the puerperium	2,395	21	1.6	507	55	0.8
O47.0	False labor before 37 completed weeks of gestation	1,930	22	1.3	1,452	21	2.3
O60.0	Preterm labor without delivery	1,880	23	1.3	909	33	1.4
O26.9	Pregnancy related conditions, unspecified	1,685	24	1.1	1,672	17	2.6
O42.9	Premature rupture of membranes, unspecified as to length of time between rupture and onset of labor	1,684	25	1.1	1,536	18	2.4

[a]Inpatient or outpatient encounters with a primary (first-listed) diagnosis

[b]Inpatient or outpatient encounters during which an indicator diagnosis was recorded in any diagnostic position

among women aged 17–24 and 25–34 years **(data not shown)**.

Pre-eclampsia

During the surveillance period, a total of 4,312 live births were affected by pre-eclampsia (6.8%) **(data not shown)**. There was a slight increase in the percentages of live births affected by pre-eclampsia among women aged 17–24 and 25–34 years during 2012–2016, and a slight decrease in the percentages among those aged 35–49 years **(Figure 2)**.

Preterm labor

During 2012–2016, a total of 11,306 live births were affected by preterm labor (17.7%). The percentage of live births affected by preterm labor decreased slightly between 2012 and 2015 for all age groups of women, followed by a more pronounced decrease in 2016 **(Figure 3)**.

Obesity complication pregnancy, childbirth, or the puerperium

Almost one-tenth (9.2%) of live births were affected by obesity complicating

FIGURE 1. Medical encounters with a primary diagnosis for any pregnancy-related complication or indication for care, and number of encounters per live birth, by age group, among service women, active component, U.S. Armed Forces, 2012–2016

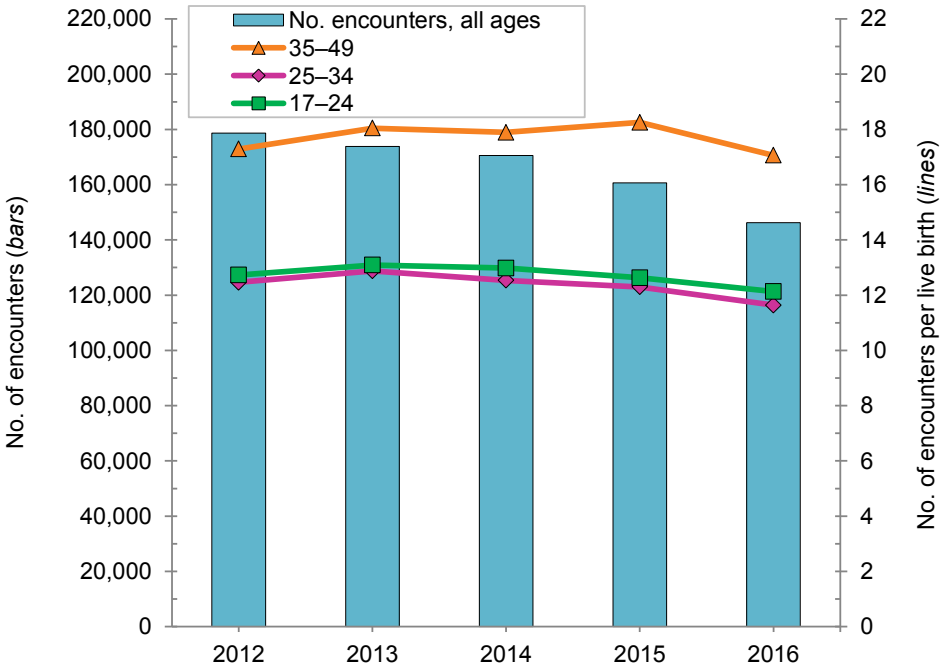
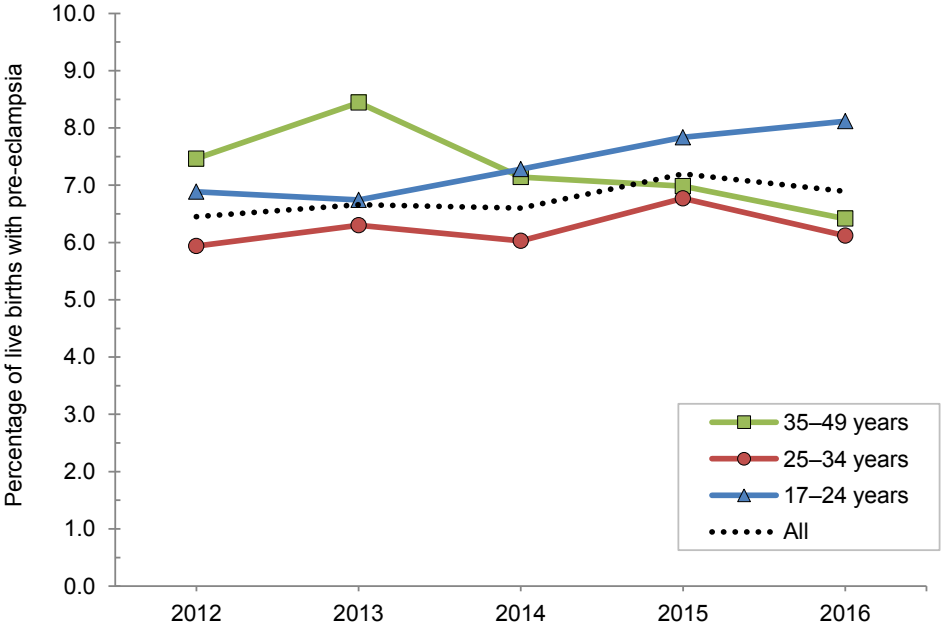


FIGURE 2. Percentage of live births with a primary diagnosis of pre-eclampsia (ICD-9: 642.4*, 642.5*; ICD-10: O14.0*, O14.1*, O14.9*), by age group and year, among service women, active component, U.S. Armed Forces, 2012–2016



pregnancy, childbirth, or the puerperium (n=5,874). The percentage of live births affected by obesity-related complications increased steadily during the surveillance period for women of all age groups, from 7.2% in 2012 to 11.4% in 2016 **(Figure 4)**. Overall, women aged 25–34 years (10.1%) and 35–49 years (10.8%) had higher percentages of live births affected by obesity complications than women aged 17–24 years (7.6%).

Gestational diabetes

During 2012–2016, a total of 4,017 (6.3%) live births were affected by gestational diabetes **(Table 3)**. The percentages of live births affected by gestational diabetes among women overall fluctuated between 5.8% and 6.8%, although annual prevalences remained consistently higher among women aged 25–34 and 35–49 years **(Figure 5)**. The percentage of live births affected by gestational diabetes was more than twice as high for obese women as for non-obese women (12.4% vs. 5.5%) **(Table 3)**. Among both obese and non-obese women, the percentage of live births affected by gestational diabetes increased with increasing age and was highest among Asians/Pacific Islanders.

EDITORIAL COMMENT

Pregnancy and delivery account for almost one-quarter of all hospitalizations for women in the military; maternal complications and delivery outcomes are therefore important components of the overall health and well-being of reproductive-age service women. The findings in this update are similar to those in a previous *MSMR* report[8]; however, the additional analyses of specific pregnancy complications allow a closer examination of some additional trends in the military population.

Because non-specific codes for complications of pregnancy were the most commonly occurring diagnoses, there were limitations to the potential conclusions that could be based on frequency of diagnoses. Diagnostic codes serve to characterize complications of pregnancy and delivery, but the most commonly used codes reveal little about the nature of these complications for the reasons stated in the Introduction. The decreasing trends in pregnancy-related medical encounters reflected the overall decrease in number of pregnancies and live births among active duty service women that occurred during the surveillance period.[9]

FIGURE 3. Percentage of live births affected by preterm labor [ICD-9: 644.0*, 644.2*; ICD-10: O60.*], by age group and year, among service women, active component, U.S. Armed Forces, 2012–2016

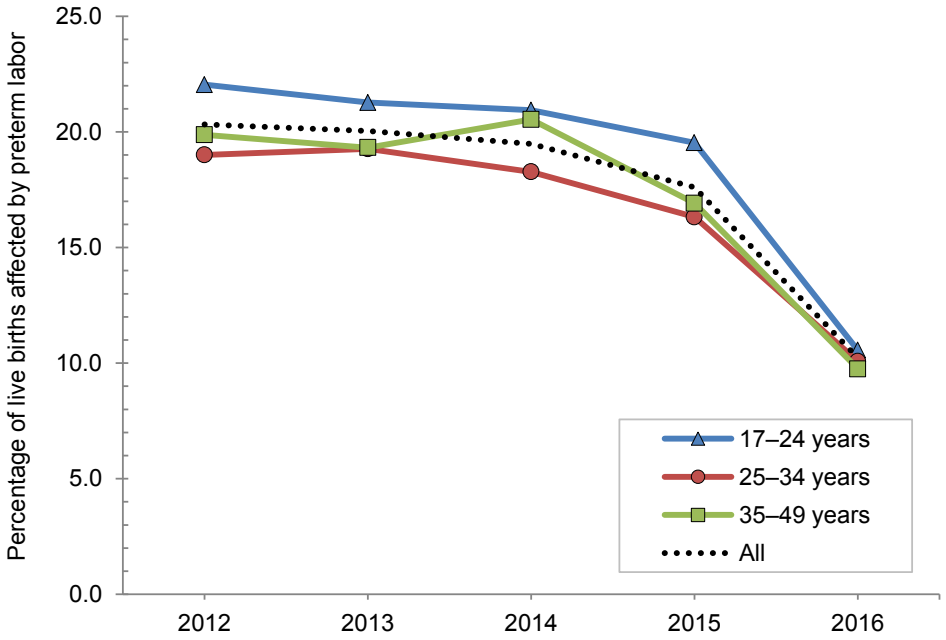
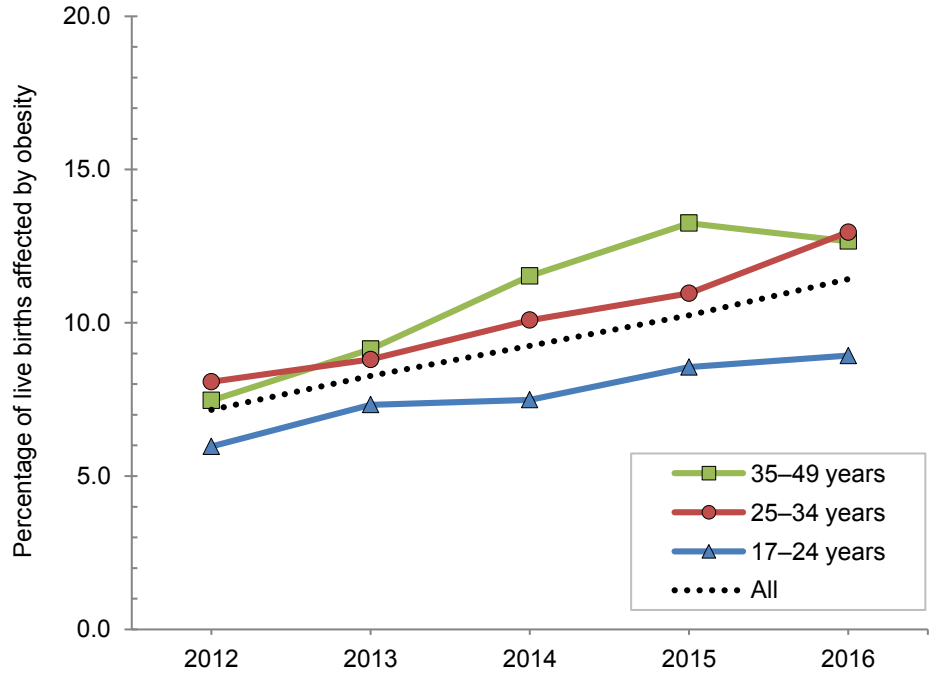


FIGURE 4. Percentage of live births affected by obesity complicating pregnancy, childbirth, or the puerperium (ICD-9: 649.1*; ICD-10: O99.21*), by age group and year, among service women, active component, U.S. Armed Forces, 2012–2016



The most striking finding in this report is the steady increase in the annual prevalence of obesity complicating pregnancy, childbirth, or the puerperium (ICD-9: 649.1*; ICD-10: O99.21*) as a diagnosis among service women who gave birth during the surveillance period. In addition to having more difficulty becoming pregnant, obese women are at increased risk for complications such as hypertensive disorders, gestational diabetes, and cesarean delivery as well as development of metabolic syndrome later in life.[10] Obese mothers are less likely to breastfeed or continue breastfeeding their children and offspring of obese mothers are also at increased risk of childhood obesity and diabetes and chronic disease later in life.[10]

The proportion of live births complicated by obesity has increased over time to a high of 11.4% of pregnancies among service women in 2016. Although this increase was seen in all age groups, women aged 35–49 and 25–34 years had the highest proportions of pregnancies complicated by obesity, reflecting what is seen in the U.S. population as a whole. In 2016, the CDC reported on new data available since the implementation of the 2003 U.S. Standard Certificate of Live Birth, available for 47 states and the District of Columbia.[11] Among women giving birth in 2014, 24.8% were obese before becoming pregnant. The proportion was lowest among those less than 24 years of age. Although the results of the current study show a lower overall proportion of obesity complicating live birth (11.4%), the trend of an increasing proportion of women with obesity complicating live birth between 2012 and 2016 is similar to what has been reported for women in the U.S. population between 2011 and 2014.[11]

Similar to what was observed with obesity complications, women aged 35–49 years had the highest proportions of gestational diabetes, and the percentage increased from 10% in 2012 to almost 12% by 2016. The U.S. population has experienced similar increases in the incidence of gestational diabetes.[6] Not surprisingly, examination of the current data demonstrated that the proportion of pregnancies complicated by gestational diabetes was higher in those who also had a diagnosis of obesity. This pattern mirrors what has been observed in the U.S. civilian population.[12]

Gestational diabetes increases the risk for other maternal complications including macrosomia, birth trauma, preeclampsia, polyhydramnios, and cesarean delivery, and can have long term implications for the health of women, including an increased risk of developing type 2 diabetes and

FIGURE 5. Percentage of live births affected by gestational diabetes, by age group and year, among service women, active component, U.S. Armed Forces, 2012–2016

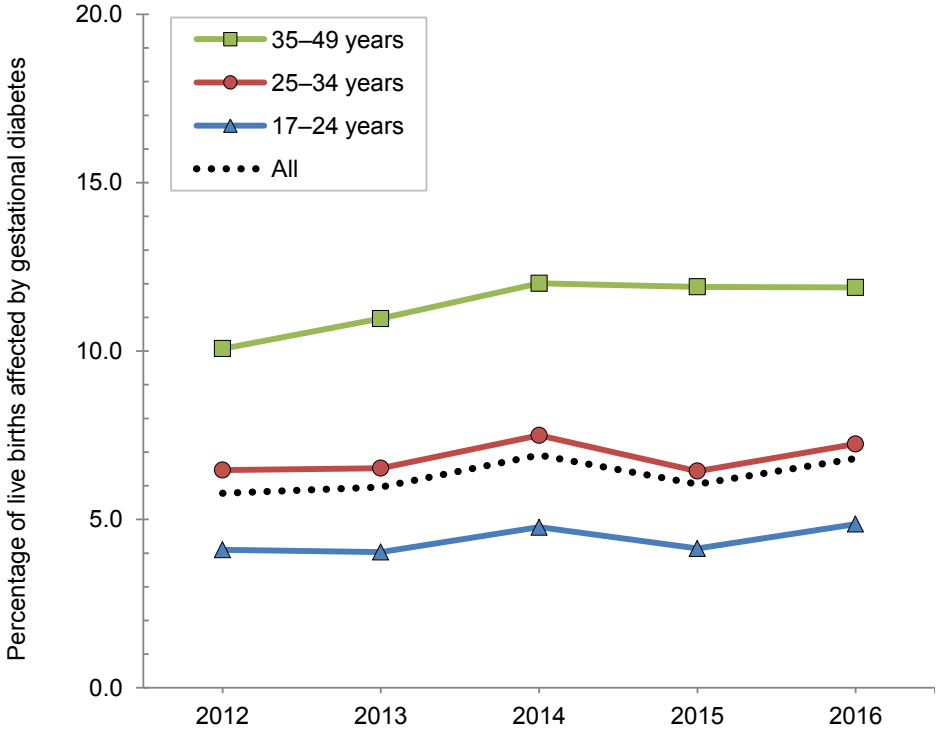


TABLE 3. Live births affected by gestational diabetes, by obesity status of mother,[a] among service women, active component, U.S. Armed Forces, 2012–2016

	Obese		Non-obese		Total	
	No.	%	No.	%	No.	%
Total	957	12.4	3,060	5.5	4,017	6.3
Age (years)						
17–24	174	10.1	900	3.9	1,074	4.4
25–34	578	12.1	1,707	5.9	2,285	6.8
35–49	205	16.2	453	10.0	658	11.4
Race/ethnicity						
Non-Hispanic white	370	11.9	1,351	5.2	1,721	5.9
Non-Hispanic black	256	11.1	584	4.3	840	5.3
Hispanic	174	13.2	526	6.0	700	6.9
Asian/Pacific Islander	63	19.0	214	9.4	277	10.6
American Indian/Alaska Native	10	10.2	57	8.1	67	8.3
Other	84	14.4	328	7.0	412	7.8

[a]ICD-9: 278.0, 278.00, 278.01, 278.03, V85.3*, V85.4*, V85.54; ICD-10: E66.01, E66.09, E66.1, E66.2, E66.8, E66.9, Z68.3*, Z68.4*

diabetes-related cardiovascular disease.[6, 12, 13] These risks justify clinical and preventive actions to address the increasing incidence of gestational diabetes among active duty service women to prevent sequelae for the mother and child and to mitigate longer-term impacts on force readiness.

Finally, the results demonstrate that the annual proportions of live births affected by preterm labor decreased over time, similar to the trend of declining preterm birth rates seen in the U.S. general population between 2007 and 2014.[14] This trend could be a result of declining birth rates among younger women, who are at higher risk for preterm delivery and, as such, is not unexpected.[15] It is worth noting that the drop in preterm deliveries between 2015 and 2016 was much more pronounced than the decline observed during 2012–2015. This more prominent decline may be due, at least in part, to the shift from ICD-9 diagnostic coding to ICD-10 that occurred near the end of calendar year 2015.

Several issues inherent to administrative databases limit the conclusions of this study. As mentioned earlier, coding practices during pregnancy limit the ability to accurately identify the most common diagnoses that service women actually experience during pregnancy. Coding practices also affect the ability to assess the prevalence of specific diagnoses. For example, obesity diagnoses are not always coded in outpatient or inpatient settings, so the actual prevalence is likely underestimated in this study. Additionally, the current report does not allow for an examination of associations between demographics and comorbidities. However, these data do serve as a useful launching point for future studies on complications during pregnancy and their impact on the health of U.S. service women.

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Incidence and Burden of Gynecologic Disorders, Active Component Service Women, U.S. Armed Forces, 2012–2016

Shauna Stahlman, PhD, MPH; Valerie F. Williams, MA, MS; Stephen B. Taubman, PhD

This report describes the incidence, burden, and co-occurrence of four common gynecologic disorders among active component service women during 2012–2016. Overall incidence rates were highest for menorrhagia (100.9 per 10,000 person-years [p-yrs]), followed by uterine fibroids (63.2 per 10,000 p-yrs), endometriosis (30.8 per 10,000 p-yrs), and polycystic ovary syndrome (PCOS, 25.3 per 10,000 p-yrs). Annual incidence rates and medical encounters for menorrhagia decreased by roughly 50% from 2012 through 2015, and then increased slightly in 2016. Annual incidence rates of PCOS decreased modestly between 2012 and 2016, whereas rates for endometriosis and uterine fibroids remained relatively stable. Service women in the Army, older service women, and non-Hispanic black service women had overall higher rates of menorrhagia, uterine fibroids, and endometriosis. Incidence of PCOS was highest among women aged 25–29 years, non-Hispanic black service women, and service women in the Air Force. Approximately one-quarter (25.6%) of women with incident endometriosis, one-third (33.6%) of women with incident uterine fibroids, and 7% of women with PCOS had a co-occurring incident diagnosis for menorrhagia during the surveillance period. Additional research focused on the severity of these conditions would allow for a fuller examination of the impact of these disorders on the readiness of the force and on healthcare utilization.

Gynecologic disorders are conditions that affect the female reproductive organs, including the uterus, ovaries, fallopian tubes, vagina, and vulva. Some of the most common disorders affecting reproductive-age women in the U.S. include menorrhagia, also known as heavy menstrual bleeding (a subset of abnormal uterine bleeding conditions); polycystic ovary syndrome (PCOS), an endocrine disorder characterized by at least two of the following: irregular menstrual periods, excess androgen levels, and ovaries with numerous small cysts; uterine fibroids, benign and often asymptomatic tumors of the uterus; and endometriosis, a condition in which the tissue of the uterine lining grows outside of the uterus and onto surrounding organs such as the ovaries and fallopian tubes.

These conditions can cause appreciable morbidity and military operational disability among service women. Menorrhagia affected 2.4% of all women serving in the active component U.S. Armed Forces between 1998 and 2012, with an overall incidence rate of 62 cases per 10,000 person-years (p-yrs).[1] The overall incidence rate of PCOS among active component women from 2000 through 2012 was 18.0 per 10,000 p-yrs (unpublished data, Armed Forces Health Surveillance Branch). Between 2001 and 2010, there were almost 12,000 incident diagnoses of uterine fibroids with an overall rate of 57.6 per 10,000 p-yrs.[2] The incidence and prevalence of endometriosis among female service members have not been documented in recent years, although one 1988 study reported the prevalence of endometriosis among female soldiers as 6.2%.[3] The prevalence of endometriosis among U.S. civilians is estimated to be 11%.[4]

The rates of menorrhagia, uterine fibroids, and PCOS have increased among active component service women during the past 15 years.[1,2] Non-Hispanic black service women had higher rates of menorrhagia and uterine fibroids, compared to their respective counterparts, but PCOS was more common among Hispanic service women and those aged 20–25 years. Co-occurring conditions are also of concern, with 15.4% of incident menorrhagia cases diagnosed between 1998 and 2012 having a co-occurring diagnosis of uterine fibroids during the same encounter.[1]

This report describes the incidence and burden of four commonly occurring gynecologic disorders (menorrhagia, PCOS, uterine fibroids, and endometriosis) among active component service women from 2012 through 2016. This report also documents the number and percentage of women with co-occurring incident diagnoses during the surveillance period.

METHODS

The surveillance period was 1 January 2012 through 31 December 2016. The surveillance population consisted of all service women who served in the active component of the U.S. Army, Navy, Air Force, or Marine Corps at any time during the surveillance period. Records of inpatient hospitalizations and outpatient encounters for outcomes of interest, as well as demographic

characteristics of the study population, were obtained from the Defense Medical Surveillance System (DMSS) database, which contains electronic medical records for all active component service members. The Theater Medical Data Store (TMDS), which maintains records for medical encounters of service members that occurred during operational deployments, and medical air transport (medical evacuation) data were evaluated independently for cases of menorrhagia only. Case definition and incidence rules were not applied to the cases identified from in-theater treatment and medical transport data, and such cases were not included in the overall analysis.

A woman was considered a case of menorrhagia if she had a record of a hospitalization with an ICD-9 code (626.2, 626.3, or 627.0) or ICD-10 code (N92.0, N92.2, or N92.4) for menorrhagia in the primary diagnostic position or records of two outpatient encounters with a defining ICD-9 or ICD-10 code in any diagnostic position within a 180-day period. An individual who met the case definition for an incident case could be counted again as an incident case if more than 365 days had passed without any healthcare encounters for menorrhagia. Women who had a diagnostic or procedural code for hysterectomy prior to diagnosis of menorrhagia were excluded from the study population time at risk for menorrhagia.[5]

An incident case of PCOS was defined by two outpatient medical encounters with a PCOS ICD-9 code (256.4) or ICD-10 code (E28.2) listed in the primary or secondary diagnostic position or one inpatient medical encounter with the PCOS ICD-9 or ICD-10 listed in the primary diagnostic position. An individual was considered a case of PCOS once during the surveillance period.

A case of uterine fibroids was defined as an individual with an inpatient or outpatient encounter with a case-defining code (ICD-9: 218.*; ICD-10: D25.*) in the primary diagnostic position; or an inpatient or outpatient encounter with a case-defining code in the second diagnostic position and an associated code for anemia due to blood loss, vaginal bleeding, menstrual bleeding disorder, or pain associated with female genital organs in the primary diagnostic position.[6] An individual could be an incident case for uterine fibroids once during the surveillance period. If an individual had a case-defining encounter for fibroids before the surveillance period or a diagnostic or procedural code for hysterectomy prior to diagnosis of uterine fibroids, she was excluded from the analysis for uterine fibroids.

Finally, a case of endometriosis was defined as an individual with two outpatient medical encounters within 180 days with a case-defining code (ICD-9: 617.*; ICD-10: N80.*) in any diagnostic position; or an inpatient encounter with a case-defining code in any diagnostic position. An individual could be an incident case for endometriosis once during the surveillance period.

To estimate the healthcare burden associated with menorrhagia, PCOS, uterine fibroids, and endometriosis, all inpatient and outpatient medical encounters with a case-defining code in the primary diagnostic position were identified separately for each diagnosis. Healthcare burdens were quantified for each year of the surveillance period as the total number of medical encounters attributable to each diagnosis, number of individuals affected, and the total number of bed days during hospitalizations. The records for incident inpatient cases of menorrhagia and uterine fibroids were analyzed to determine the most common procedures that were performed during the same incident hospitalizations, using only the procedures listed in the primary positions.

RESULTS

Menorrhagia

During the 5-year surveillance period, 9,060 unique active component service women (2.6% of all women who served during the period) were identified as incident cases of menorrhagia on at least one occasion. Among these women, there were 9,609 incident cases of menorrhagia diagnosed (crude rate of 100.9 per 10,000 p-yrs) **(Table 1)**. Annual incidence rates of menorrhagia decreased by 53.0% from 136.2 per 10,000 p-yrs in 2012 to 64.0 per 10,000 p-yrs in 2015, and then increased slightly to 67.6 per 10,000 p-yrs in 2016 **(Figure 1)**. Inpatient hospitalizations accounted for 6.3% (n=607) of the total menorrhagia cases and 9,002 were outpatient cases **(data not shown)**. In addition to the cases diagnosed in fixed medical facilities, TMDS records documented 941 menorrhagia-related medical encounters affecting 718 unique individuals during deployment to a U.S. Central Command area of responsibility. An additional nine women were evacuated from theater due to menorrhagia **(data not shown)**.

Service women aged 40 years or older had more than three times the incidence rates of menorrhagia as service women in their early 30s (362.0 per 10,000 p-yrs and 101.3 per 10,000 p-yrs, respectively) and more than eight times the rate among service women in their early 20s (43.4 per 10,000 p-yrs) **(Table 1)**. Non-Hispanic black women (169.7 per 10,000 p-yrs), service women in the Army (136.3 per 10,000 p-yrs), and service women in communications/intelligence (124.4 per 10,000 p-yrs) or healthcare occupations (115.7 per 10,000 p-yrs) had the highest overall rates of menorrhagia, compared to their respective counterparts.

During 2012–2016, an average of 3,859 individuals per year had an average of 6,000 medical encounters and 391 bed days per year for menorrhagia. However, the burden of care declined during the surveillance period, in that the annual numbers of encounters, individuals affected, and bed days fell by 45%, 36%, and 69%, respectively, between 2012 and 2016 **(Figure 2)**.

During the 607 incident hospitalizations for menorrhagia during the surveillance period, 53.9% of them were associated with a primary (first-listed) procedure code for hysterectomy, 10.7% for myomectomy, and 15.7% for other procedures **(Figure 3)**. The percentage of incident hospitalizations with a primary procedure for hysterectomy peaked in 2015 at 65.8% and then decreased in 2016 to 50.5%. In contrast, the percentage of myomectomies and "other" procedures (e.g., transfusion of packed red blood cells, excision of ovaries) increased from 2012 through 2016. During the entire period, 19.7% of hospitalizations

TABLE 1. Incident cases and incidence rates of gynecologic disorders, active component service women, U.S. Armed Forces, 2012–2016

	Menorrhagia		PCOS		Uterine fibroids		Endometriosis	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total	9,609	100.9	2,530	25.3	6,122	63.2	3,066	30.8
Age								
<20	312	44.2	94	13.1	10	1.4	45	6.3
20–24	1,358	43.4	950	29.1	306	9.3	616	18.8
25–29	1,262	52.5	845	34.0	758	30.3	649	26.0
30–34	1,576	101.3	454	28.5	1,260	80.2	572	35.7
35–39	2,341	243.0	148	14.6	1,653	177.4	606	60.4
40+	2,760	362.0	39	4.3	2,135	309.2	578	66.7
Race/ethnicity								
Non-Hispanic white	3,455	80.4	1,078	24.0	1,390	31.5	1,365	30.6
Non-Hispanic black	4,169	169.7	737	28.2	3,596	148.3	975	37.5
Hispanic	1,066	73.3	381	25.1	532	35.5	361	23.8
Asian/Pacific Islander	246	60.8	74	17.4	166	39.8	90	21.2
Other/unknown	673	74.2	260	27.5	438	47.1	275	29.1
Military grade								
Enlisted	7,572	98.2	2,158	26.8	4,526	57.4	2,505	31.1
Officer	2,037	112.5	372	19.4	1,596	88.4	561	29.4
Service								
Army	4,473	136.3	940	26.9	3,013	90.5	1,258	36.2
Navy	1,628	61.3	629	22.5	1,123	40.8	635	22.7
Air Force	3,140	108.5	846	28.4	1,858	64.0	1,048	35.2
Marine Corps	368	53.4	115	16.3	128	18.2	125	17.7
Military occupation								
Infantry/artillery/combat engineering	114	63.6	31	16.2	71	37.5	34	17.7
Armor/motor transport	257	89.8	70	23.0	158	53.0	97	31.9
Pilot/air crew	87	64.7	28	19.6	49	34.6	32	22.4
Repair/engineer	1,351	72.0	468	23.7	800	41.0	507	25.6
Communication/intelligence	3,938	124.4	911	27.3	2,511	78.2	1,139	34.3
Health care	2,174	115.7	581	29.8	1,406	75.5	726	37.4
Other	1,688	84.5	441	21.2	1,127	55.4	531	25.6
Marital status								
Married	5,258	122.3	1,374	30.6	3,223	74.4	1,806	40.3
Unmarried	2,693	61.6	953	20.8	1,772	39.3	837	18.3
Other	1,658	194.2	203	22.1	1,127	133.0	423	46.8

[a]Rate per 10,000 person-years

for menorrhagia had no associated procedure documented. However, the annual proportions of hospitalizations without documented procedures declined sharply from 2012 to 2016 **(Figure 3)**.

PCOS

During the 5-year surveillance period, 2,530 individuals were identified as incident cases of PCOS among active component service women **(Table 1)**. The overall incidence rate of PCOS was 25.3 cases per 10,000 p-yrs. Annual incidence rates decreased modestly from 26.4 cases per 10,000 p-yrs in 2012 to 21.0 cases per 10,000 p-yrs in 2016 **(Figure 1)**. The overall incidence rates of PCOS were highest among service women aged 25–29 years (34.0 per 10,000 p-yrs) and lowest among those aged 40 years or older (4.3 per 10,000 p-yrs) **(Table 1)**. Overall incidence rates were highest among non-Hispanic black service women (28.2 per 10,000 p-yrs) and those of "other" or unknown race/ethnicity (27.5 per 10,000 p-yrs). Compared to their respective counterparts, rates of PCOS were highest among service women in the Air Force (28.4 per 10,000 p-yrs), enlisted personnel (26.8 per 10,000 p-yrs), those in

FIGURE 1. Annual incidence rates of gynecologic disorders, active component service women, U.S. Armed Forces, 2012–2016

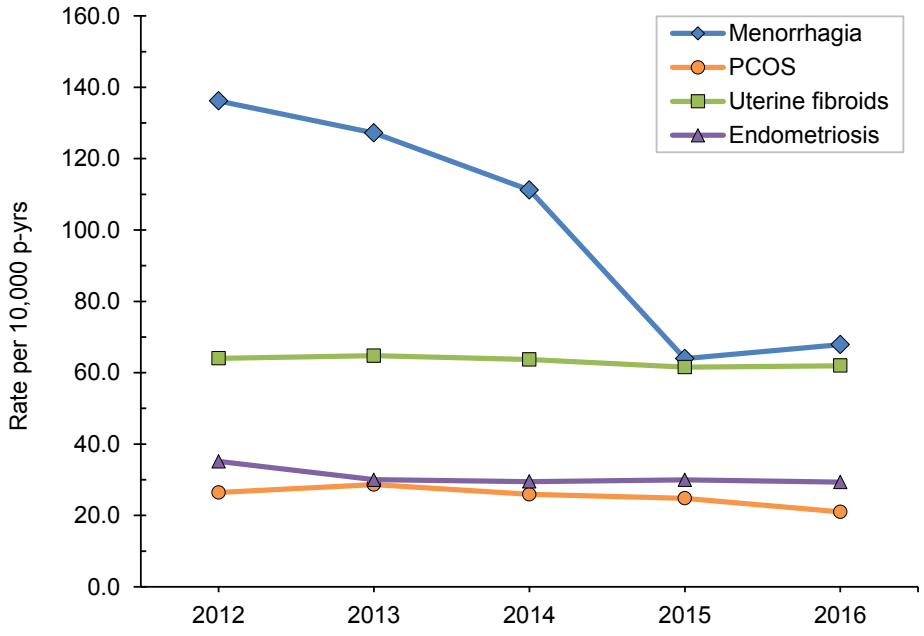
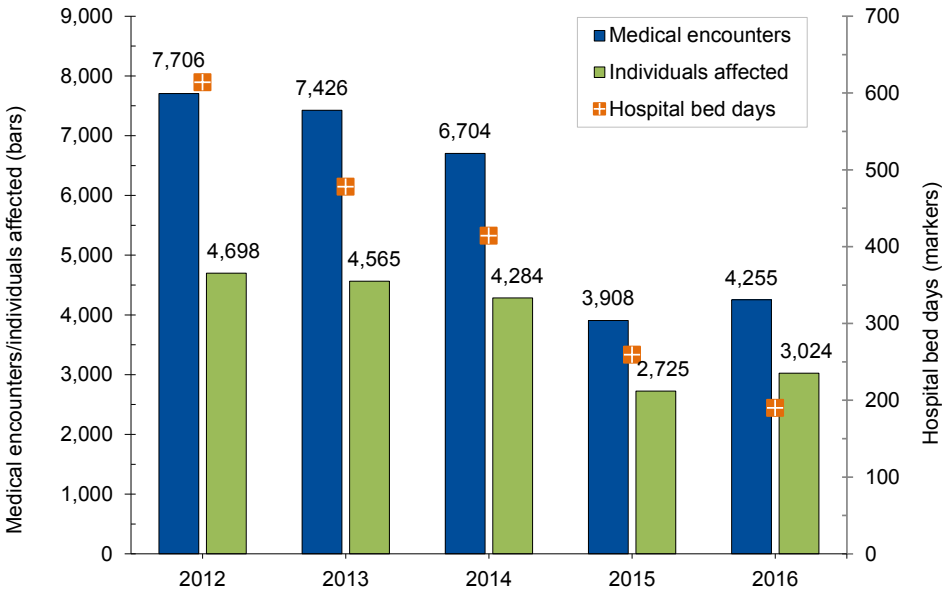


FIGURE 2. Burden of menorrhagia, active component service women, U.S. Armed Forces, 2012–2016



healthcare (29.8 per 10,000 p-yrs) occupations, and married women (30.6 per 10,000 p-yrs).

During 2012–2016, an average of 1,184 individuals per year had an average of 1,972 medical encounters per year for PCOS. The burden of care for PCOS as measured by the annual numbers of encounters was only 6% lower in 2016 than in 2012, and the numbers of individuals affected were relatively stable from 2012 to 2016 **(Figure 4).**

Uterine fibroids

During the surveillance period, there were 6,122 incident diagnoses of uterine fibroids (63.2 per 10,000 p-yrs) **(Table 1).** Hospitalized cases (n=272) accounted for 4.4% of all incident encounters **(data not shown).** The annual incidence rates of uterine fibroids remained relatively stable from 2012 through 2016, fluctuating between 61.5 and 64.8 cases per 10,000 p-yrs **(Figure 1).**

Overall rates of incident diagnoses of uterine fibroids increased with increasing age. The highest rate occurred among service women aged 40 years or older (309.2 per 10,000 p-yrs). Overall incidence rates of uterine fibroids were highest among service women in the Army (90.5 per 10,000 p-yrs) and among those in communications/intelligence (78.2 per 10,000 p-yrs) or healthcare occupations (75.5 per 10,000 p-yrs). The overall rate among non-Hispanic black women (148.3 per 10,000 p-yrs) was more than four times that of non-Hispanic white women (31.5 per 10,000 p-yrs) **(Table 1).** Compared to those in all other race/ethnicity groups, non-Hispanic black women had higher rates of uterine fibroids in every age group, and rate differences increased with increasing age **(data not shown).**

During 2012–2016, an average of 2,054 individuals per year were associated with annual averages of 4,311 medical encounters and 1,059 bed days for uterine fibroids. The burden of care for uterine fibroids as measured by the annual numbers of encounters was only 10% lower in 2016 than in 2012, and the numbers of individuals affected fell by only 7% between 2012 and 2016 **(Figure 5).**

Of the 272 incident hospitalizations for uterine fibroids during the surveillance period, 65.8% had a primary (first-listed) code for hysterectomy and 18.8% for myomectomy **(Figure 6).** The percentage of incident hospitalizations with a primary procedure for hysterectomy decreased only slightly, from 67.9% in 2012 to 63.2% in 2016, whereas the percentage of myomectomies increased from 7.1% to 22.8%. There were only 8 (2.9%) incident hospitalizations for "other" procedures.

Endometriosis

There were 3,066 individuals diagnosed with endometriosis during 2012–2016, with an overall incidence rate of 30.8

FIGURE 3. Percentages of selected medical/surgical procedures (primary position) during menorrhagia incident hospitalizations, active component service women, U.S. Armed Forces, 2012–2016

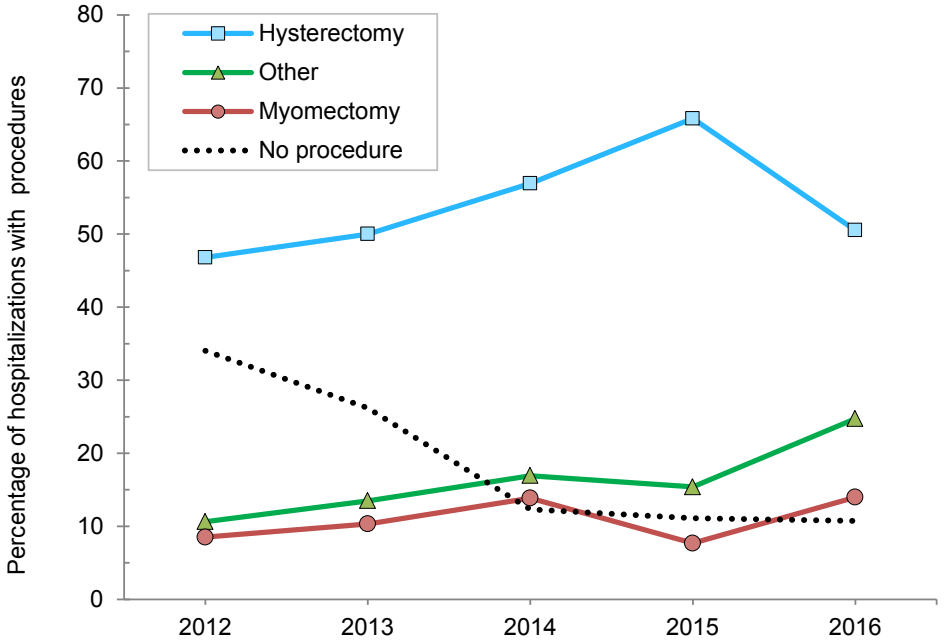
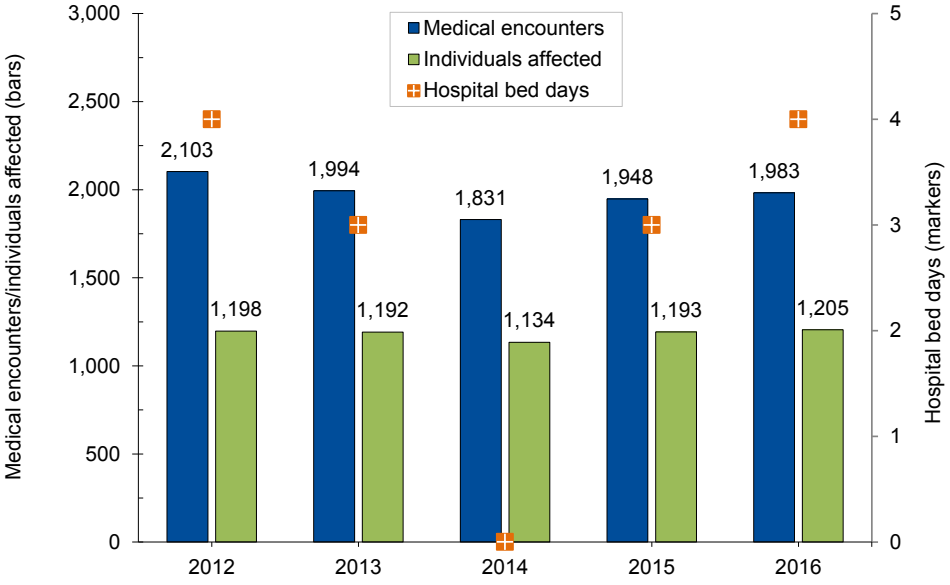


FIGURE 4. Burden of polycystic ovarian syndrome (PCOS), active component service women, U.S. Armed Forces, 2012–2016



cases per 10,000 p-yrs **(Table 1)**. The annual incidence rate decreased from 35.1 cases per 10,000 p-yrs in 2012 to 30.0 cases per 10,000 p-yrs in 2013, and then remained stable for the duration of the surveillance period **(Figure 1)**. The overall incidence rates of endometriosis increased with increasing age, with women aged 40 years or older having more than three times the rate of endometriosis as women aged 20–29 years (66.7 and 21.9 per 10,000 p-yrs, respectively). Overall incidence rates were highest among non-Hispanic black service women (37.5 per 10,000 p-yrs). Compared to their respective counterparts, overall rates of endometriosis were highest among service women in the Army (36.2 per 10,000 p-yrs) and women in healthcare occupations (37.4 per 10,000 p-yrs).

During 2012–2016, an average of 1,113 individuals per year were associated with annual averages of 2,470 medical encounters and 195 bed days for endometriosis. The burden of care for endometriosis as measured by the annual numbers of encounters was only 13% lower in 2016 than in 2012, and the numbers of individuals affected fell by only 11% between 2012 and 2016 **(Figure 7).**

Co-occurring diagnoses

Of the 9,060 women with incident menorrhagia diagnoses during the surveillance period, 22.7% were also diagnosed as incident cases of uterine fibroids, 8.7% with endometriosis, and 2.0% with PCOS **(Table 2)**. Of the 2,530 women with incident PCOS diagnoses, 7.0% were also diagnosed as incident cases of menorrhagia, 3.6% with endometriosis, and 2.6% with uterine fibroids. Of the 6,122 women diagnosed with uterine fibroids, 33.6% also had incident diagnoses of menorrhagia, 9.3% of endometriosis, and 1.1% of PCOS. Finally, of the 3,066 incident endometriosis cases, 25.6% also had incident diagnoses of menorrhagia, 18.5% with uterine fibroids, and 3.0% with PCOS.

EDITORIAL COMMENT

Results of the current analysis indicate that annual incidence rates of menorrhagia decreased by 53.0% between 2012 and 2016 followed by a slight increase in 2016. As in the general U.S. population, overall rates of incident diagnoses of menorrhagia were highest among older premenopausal and non-Hispanic black service women.[7-9] The higher rates of menorrhagia among non-Hispanic black women compared to women in the other race/ethnicity groups may be attributable to the higher incidence of uterine fibroids among African-American women and the potential biological differences in their hormonal

FIGURE 5. Burden of uterine fibroids, active component service women, U.S. Armed Forces, 2012–2016

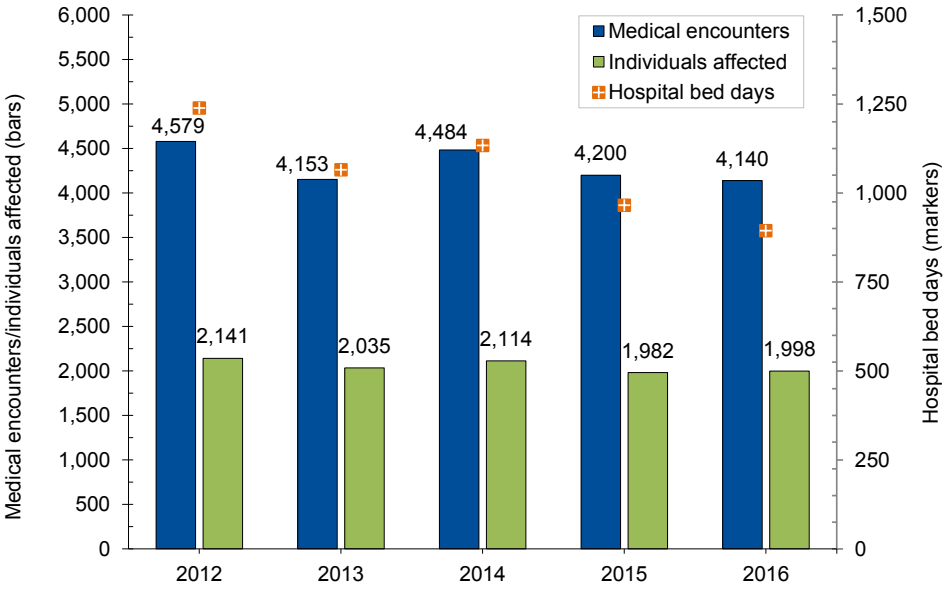
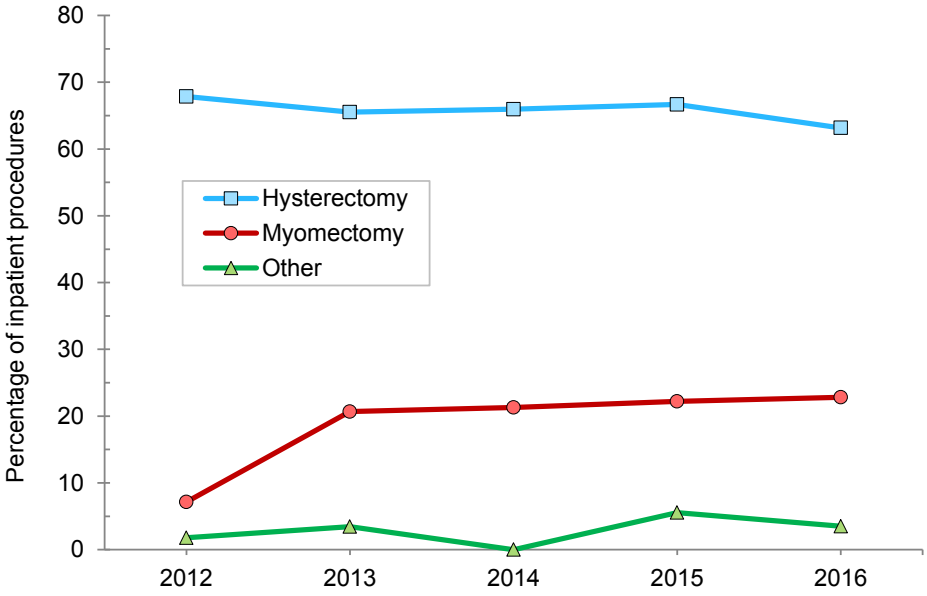


FIGURE 6. Percentages of selected medical/surgical procedures (primary position) during uterine fibroid incident hospitalizations, active component service women, U.S. Armed Forces, 2012–2016



milieu.[8-12] Among the service women with incident diagnoses of menorrhagia in the study population, uterine fibroids were the most commonly associated co-occurring diagnosis. This finding is not unexpected given that menorrhagia is a common complication of uterine fibroids.[13] Consistent with the published literature on the surgical management of menorrhagia in the U.S. civilian population, hysterectomies were the procedures most frequently recorded during incident menorrhagia-related hospitalizations.[14,15]

Annual incidence rates of PCOS decreased modestly between 2012 and 2016. The overall incidence rates of PCOS were highest among service women aged 25–29 years and lowest in those aged 40 years or older, a pattern similar to that observed in the prevalence of PCOS among women in the general population.[16,17] In addition, overall incidence rates of PCOS among non-Hispanic black service women and those of "other" or unknown race/ethnicity were higher than the rates among their non-Hispanic white, Hispanic, and Asian/Pacific Islander counterparts. Reported racial differences in PCOS prevalence among civilian women are minor and mixed. Some research findings suggest that non-Hispanic whites and non-Hispanic blacks may have lower prevalences of PCOS, compared to certain other race/ethnicity groups (e.g., Mexican-American), although these results require confirmation in larger and more diverse study populations.[18-20]

Among the service women with incident diagnoses of PCOS in the study population, the highest prevalence of co-occurrence was with menorrhagia (7.0%). Estimates of the co-occurrence of these conditions in the general population are lacking in the published literature.

An earlier *MSMR* report documented a marked increase in annual incidence rates of uterine fibroids among active component service women during 2001–2010, with an overall incidence rate of 57.6 cases per 10,000 p-yrs.[2] Results of the current analysis indicate that, from 2012 through 2016, annual incidence rates of uterine fibroids remained relatively stable and fluctuated between 61.5 and 64.8 cases per 10,000 p-yrs. A recent systematic review revealed that wide ranges were reported in both uterine fibroid incidence (21.7–374.5 cases per 10,000 p-yrs) and prevalence (4.5–68.6%) among women in the general population.[21] During 2012–2016, overall rates of incident diagnoses of uterine fibroids were highest among older premenopausal and non-Hispanic black service women. Comparable racial/ethnic disparities in the incidence of uterine fibroids are apparent in the U.S. civilian population, with black women having a threefold greater incidence of uterine fibroids, compared to white women.[21-23]

As with inpatient cases of menorrhagia, hysterectomies were the procedures most frequently recorded during incident uterine fibroid–related hospitalizations. This finding is consistent with published

FIGURE 7. Burden of endometriosis, active component service women, U.S. Armed Forces, 2012–2016

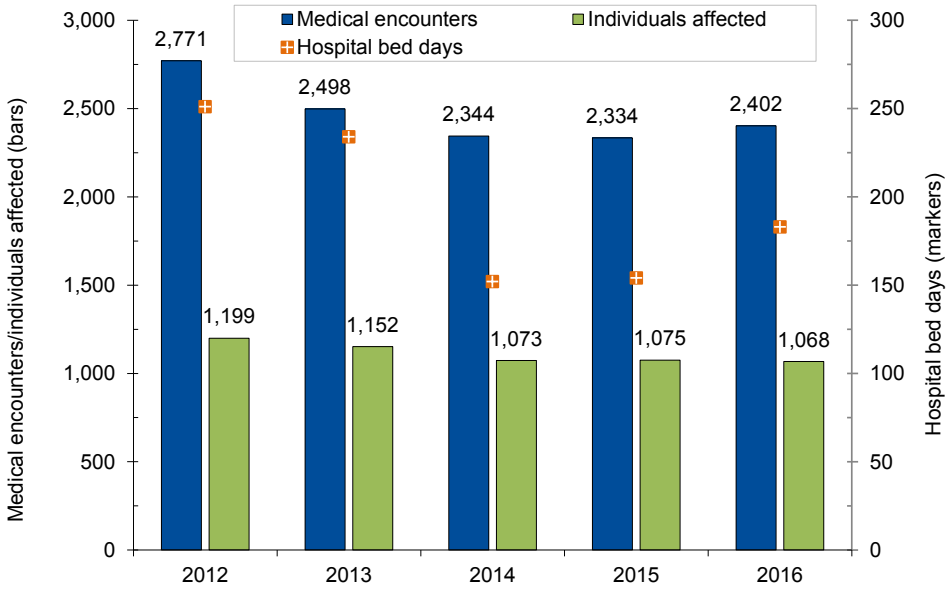


TABLE 2. Number and percentage of active component service women with multiple incident diagnoses of gynecologic disorders of interest, U.S. Armed Forces, 2012–2016

	Menorrhagia		PCOS		Uterine fibroids		Endometriosis	
Co-occurring condition	No.	%	No.	%	No.	%	No.	%
Menorrhagia	-	-	177	7.0	2,058	33.6	785	25.6
PCOS	177	2.0	-	-	67	1.1	91	3.0
Uterine fibroids	2,058	22.7	67	2.6	-	-	568	18.5
Endometriosis	785	8.7	91	3.6	568	9.3	-	-
Total incident cases	9,060	-	2,530	-	6,122	-	3,066	-

PCOS, polycystic ovary syndrome

reports on procedures used to treat uterine fibroids among women in the general U.S. population.[24]

During 2012–2016, the overall incidence rate of endometriosis among active component service women was 30.8 cases per 10,000 p-yrs. Endometriosis incidence estimates from population-based studies in the U.S. range from 10.9 to 24.7 cases per 10,000 p-yrs, depending on diagnostic method and sampling framework.[25-27] Estimates are highest from studies of symptomatic (chronic pelvic pain) or infertile women seeking clinical care.[4,27]

Similar to the findings for menorrhagia and uterine fibroids, overall incidence rates of endometriosis were highest among non-Hispanic black service women and women aged 40 years or older. The latter finding of increasing incidence with increasing age mirrors that seen among women in the U.S. civilian population.[4,28] However, studies carried out in the past 25 years among women in the general population have had conflicting results for racial and ethnic differences in endometriosis.[28] Additional research is needed to further investigate and clarify possible racial and ethnic differences among women with endometriosis.

In the current study, 18.5% of the women with incident endometriosis also were diagnosed as incident cases of uterine fibroids. Results from studies of women seeking surgical treatment for either condition suggest that uterine fibroids and endometriosis commonly co-exist, although the reported prevalences vary markedly.[29-32] Both diseases are steroid hormone-dependent and respond similarly under the influence of estrogen.[33,34] In addition, both uterine fibroids and endometriotic tissue express aromatase, which produces a hyperestrogenic environment that may increase susceptibility to both conditions.[33-35]

There are several important limitations that should be considered when interpreting the results of this analysis. First, some women with the gynecologic disorders of interest may not seek care for their symptoms.[36,37] Furthermore, the diagnoses of PCOS, uterine fibroids, and endometriosis can be challenging because these disorders can have varied and non-specific presentations (with endometriosis, definitive diagnosis typically requires surgery). Finally, women with uterine fibroids and endometriosis may be asymptomatic and may not have been captured in this study of administrative data. All of these issues likely contribute to underestimation of the true incidence and burden of these diseases among the female population. Alternatively, among asymptomatic women, it is unclear what proportions of these disorders are diagnosed based on incidental detections.

Another limitation of the current analysis is specific to the examination of medical/surgical procedures during incident menorrhagia or uterine fibroid-related encounters. For this analysis, procedure codes recorded during outpatient encounters were not examined; menorrhagia and uterine fibroid treatments that did not require hospitalization were not included in the analysis. Future studies of these disorders should include procedure codes from outpatient encounters, as most laparoscopic hysterectomy and myomectomy procedures now are performed in ambulatory surgery settings.[24] Furthermore, the levonorgestrel intrauterine system is increasingly being used to treat menorrhagia, but prescriptions and procedure codes for that treatment were outside the scope of this analysis.[38]

The current analysis provides an overview of the incidence and burden of menorrhagia, PCOS, uterine fibroids, and endometriosis during a 5-year period among active component service women and the impact of these conditions on the military healthcare system. Of the four gynecologic disorders of interest, uterine fibroids and menorrhagia were associated with the highest overall burdens, respectively. Menorrhagia, specifically, can decrease a service woman's military readiness, affect her field training, and affect her ability to deploy.[39-41] This condition is also important in the context of daily duties because it may increase clinic visits and decrease productivity.[9,15,42]

Although the severity of diseases in female service members was not evaluated in this analysis, these disorders undoubtedly cause symptomatic women appreciable morbidity and military operational disability. Additional research focused on the severity of these gynecologic conditions among service women would allow for a fuller examination of the impact of these disorders on the readiness of the force and on healthcare utilization.

Acknowledgment: The authors thank Dr. Catherine T. Witkop (Department of Preventive Medicine and Biostatistics, Uniformed Services University of the Health Sciences, Bethesda, MD) for her review of this work and valuable input into the Editorial Comment.

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Erratum: Armed Forces Health Surveillance Center. Brief report: Polycystic ovary syndrome, active component service women, U.S. Armed Forces, 2000–2012. *MSMR*. 2013;20(9):13–14.

The 2013 MSMR brief report on polycystic ovary syndrome (PCOS) describes the incidence of PCOS from 2000 to 2012. The article states that "[a]n incident case of PCOS was defined as two outpatient medical encounters with a PCOS ICD-9 code (256.4) listed in the primary or secondary diagnostic position or one inpatient medical encounter with the PCOS ICD-9 listed in the primary diagnostic position." However, it has come to our attention that the case definition applied in that analysis actually defined an incident case of PCOS as two outpatient medical encounters occurring within 1 day of each other with a PCOS ICD-9 code (256.4) listed in the primary or secondary diagnostic position or one inpatient medical encounter with the PCOS ICD-9 code listed in the primary diagnostic position. Given this difference in case definitions, comparisons of rates for PCOS in the article in this issue of the MSMR with those from the 2013 brief report are not valid.

–The MSMR Editors

Department of Defense Birth and Infant Health Registry: Select Reproductive Health Outcomes, 2003–2014

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Established following a 1998 directive, the Department of Defense Birth and Infant Health Registry (Registry) team conducts surveillance of select reproductive health outcomes among military families. Data are compiled from the Military Health System Data Repository and Defense Manpower Data Center to define the Registry cohort and outcomes of interest. Outcomes are defined using ICD-9/ICD-10 and Current Procedural Terminology codes, and include: pregnancy outcomes (e.g., live births, losses), birth defects, preterm births, and male:female infant sex ratio. This report includes data from 2003–2014 on 1,304,406 infants among military families and 258,332 pregnancies among active duty women. Rates of common adverse infant and pregnancy outcomes were comparable to or lower than those in the general U.S. population. These observations, along with prior Registry analyses, provide reassurance that military service is not independently associated with increased risks for select adverse reproductive health outcomes. The Registry's diverse research portfolio demonstrates its unique capabilities to answer a wide range of questions related to reproductive health. These data provide the military community with information to identify successes and areas for improvement in prevention and care.

The Department of Defense Birth and Infant Health Registry (Registry) was established following a 1998 directive from the Assistant Secretary of Defense for Health Affairs.[1] Prior to the establishment of the Registry, the absence of baseline data hindered the ability to evaluate effects of military-unique exposures of potential concern on reproductive health outcomes. The Registry is an important resource for monitoring the reproductive health of military families and findings are frequently shared through scientific conferences, peer-reviewed journals, special reports, and annual reporting of the prevalence of birth defects through a partnership with the National Birth Defects Prevention Network (NBDPN). Registry data are collected, maintained, and analyzed by the Deployment Health Research Department at the Naval Health Research Center in San Diego, CA.

Outcomes among active duty mothers are a subset of the Registry's data, which document maternal, pregnancy, and infant outcomes among all military families (i.e., TRICARE beneficiaries). Hence, the Registry's data comprise a large study population for assessing parental exposures, outcomes among dependent spouses, and differences between military and civilian populations. This report describes characteristics and outcomes among infants born to active duty women in calendar years 2003–2014, with additional data presented on pregnancies among active duty women and on outcomes for the Registry population as a whole, for this same time frame.

METHODS

Population and data sources

The Registry comprises data pertaining to a population-based, retrospective cohort of infants and pregnancies among U.S. military families and currently includes data on nearly 1.8 million infants born during 1998–2014. The military parent acts as the sponsor, or primary beneficiary of TRICARE coverage, and family members are dependent beneficiaries through the sponsor. Maternal/sponsor and infant data are compiled from the Military Health System Data Repository (MDR) and Defense Manpower Data Center (DMDC). The MDR houses administrative medical claims data for both inpatient and outpatient encounters at military and civilian treatment facilities. Medical encounters are coded with International Classification of Diseases, Ninth/Tenth Revision, Clinical Modification/Procedure Coding System (ICD-9/ICD-10) diagnostic and procedure codes, as well as Current Procedural Terminology (CPT) codes. For this report, ICD-10 codes were used only for defining birth defects among infants born during the last 3 months of 2014, because their first years of life overlapped the first 3 months after ICD-10 coding went into effect (1 October 2015). Medical encounter data, along with TRICARE enrollment and eligibility data maintained by DMDC, are used to define the Registry infant cohort (including their mothers and military sponsors) and to ascertain outcomes through the first year of the infants' lives. Same-sex multiple infants are excluded from the Registry due to difficulties in differentiating their medical records. Estimated gestational age (EGA) is derived from ICD codes, and the estimated date of last menstrual period (LMP)

is calculated by subtracting EGA from the delivery date.

The Registry data have a lag of approximately 2 years: 1 year for all infants in a cohort year to reach 1 year of age, and 1 year for the medical encounter data to be fully populated. Although the Registry includes data on infants born as far back as 1998, for most studies/reports the data are limited to those infants born in 2003 or later. This limitation is due to changes in ICD-9 coding for gestational age, which were implemented at that time and allow for more granularity in the assignment of gestational age and improve accuracy when assessing the timing of exposures relative to pregnancy.

The Registry also includes data on pregnancies, including those that do not result in live deliveries, for women who were active duty service members through the duration of their pregnancies. To estimate the LMP of pregnancies not ending in live deliveries, the median number of days from LMP to start of pregnancy care for live deliveries is subtracted from the earliest date of pregnancy care. EGA is determined by calculating the difference between estimated LMP and pregnancy end date (for pregnancies ending in loss) or last date of pregnancy care (for pregnancies with unknown outcomes). For all pregnancies, the expected date of delivery (EDD) is calculated by adding 40 weeks to LMP.

Outcomes

The Registry routinely captures data on the male:female infant sex ratio, an indicator of overall population reproductive health,[2] as well as on adverse infant outcomes, including major birth defects, preterm birth, and low birth weight (LBW). Birth defects are defined using the current case definitions from the NBDPN,[3] which are based on ICD-9 and ICD-10 codes in the ranges of 740.x–760.x and Q00–Q99, respectively. At least one inpatient diagnosis or two outpatient diagnoses on different days are required for a birth defect to be included as a case. Preterm birth, or birth before 37 completed weeks of gestation, is based on an infant's EGA at birth, defined by ICD-9 codes from records of the infant or mother: weeks of gestation 756.2; preterm birth 765.x; postterm newborn 766.2x; multiple birth V3[1-5].xx; preterm delivery 644.2x; postterm pregnancy 645.[1,2]x; or multiple gestation or delivery 651.xx, V27.[2,3,5,6]x.

LBW (i.e., birth weight under 2,500 grams) is determined from ICD-9 codes 764.xx, 765.0x, and 765.1x; the fifth digit indicates a birth weight category. The first code recorded within 28 days of an infant's birth is used to establish the weight category. If more than one code is assigned on the same day, the lowest recorded weight is used. Infants with no weight codes in their records are assumed to be of normal birth weight.

Pregnancies and their outcomes are defined using pregnancy-related ICD-9 diagnostic codes in the range of 630.x–679.x, as well as ICD-9 and CPT procedure codes. Pregnancy outcomes described in this report include live deliveries, stillbirths, all other pregnancy losses, and unknown outcomes. Live deliveries are defined by a maternal live delivery ICD-9 code (V27.[0,2,3,5,6]) on an inpatient encounter record that links to a live born infant. In the absence of a live delivery, a pregnancy is classified as having ended in a loss if there is an ICD-9 code indicating pregnancy loss (ectopic and molar pregnancy 630.xx–633.xx; other pregnancy with abortive outcome 634.xx–639.xx; intrauterine fetal death/stillbirth 656.4x; V27.[1,3,4,6,7]) or an ICD-9 or CPT code indicating treatment of a pregnancy loss, and there are no encounters in the subsequent 60 days indicating an ongoing pregnancy. Among pregnancies classified as losses, stillbirths are defined as those with an ICD-9 stillbirth code (intrauterine fetal death 656.4x; outcome of delivery V27.[1,3,6,7]) on an inpatient encounter record at the end of the pregnancy. Pregnancies that cannot be defined as live deliveries or losses, due to loss to follow-up or conflicting pregnancy data, are classified as having unknown outcomes. Pregnancies with any indication of an elective abortion are excluded from reporting (ICD-9 diagnostic codes: legally induced abortion 635.xx; illegally induced abortion 636.xx; ICD-9 procedure codes: intra-amniotic injection for abortion 75.0; hysterotomy to terminate pregnancy 74.91; dilation and curettage for termination of pregnancy 69.01; aspiration curettage of uterus for termination of pregnancy 69.51; CPT codes: induced abortion by dilation and curettage 59840; induced abortion by dilation and evacuation 59841; induced abortion by one or more intra-amniotic injections 59850–59852; or, induced abortion by 1 or more vaginal suppositories 59855–59857).

Covariates

Outcomes are described according to a variety of maternal/sponsor and infant covariates. Maternal demographic data, other than age, are available only when the mother is the military sponsor. Maternal age at infant's date of birth (or at EDD for pregnancies) is reported in both categorical and continuous form. Additional maternal/sponsor covariates include marital status (married, not married), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Asian/Pacific Islander, American Indian/Alaska Native, other/unknown), educational attainment (less than a bachelor's degree, bachelor's degree or greater), branch of service, military pay grade (E1–E3, E4–E6, E7–E9, O1–O3, O4–O9, W1–W5, unknown), military rank (enlisted, officer, warrant officer, unknown), and military occupation (combat specialist, healthcare specialist, other/unknown). Infant covariates include year of birth, birth facility type (military, civilian, unknown), and plurality (singleton, multiple).

RESULTS

Population characteristics

Registry records reviewed for this report covered 1,304,406 infants born in 2003–2014, including 174,921 (13%) born to active duty women and 1,043,812 (80%) born to dependent spouses of active duty service members **(Table 1)**. Infants born to Reserve/National Guard mothers and other beneficiary types (e.g., retirees) make up the remaining 7%. Active duty mothers were slightly younger than dependent spouse mothers. Compared with the military sponsors of dependent spouses, active duty mothers were more likely to be non-white,

TABLE 1. Characteristics of infants, by maternal beneficiary type, Department of Defense Birth and Infant Health Registry, 2003–2014

	Maternal beneficiary type					
	Active duty (N=174,921)		Dependent spouse (N=1,043,812)		Registry overall (N=1,304,406)	
Characteristics	No.	%	No.	%	No.	%
Maternal age at infant birth (years)						
<20	5,315	3.0	45,353	4.3	61,094	4.7
20–24	76,617	43.8	334,909	32.1	424,516	32.5
25–29	52,349	29.9	347,851	33.3	408,765	31.3
30–34	27,408	15.7	213,556	20.5	246,909	18.9
35–39	11,190	6.4	84,670	8.1	98,797	7.6
≥40	2,042	1.2	17,473	1.7	20,625	1.6
Unknown	0	-	0	-	43,700	3.4
Mean (SD)	26.0	(5.1)	27.0	(5.3)	26.8	(5.3)
Median (IQR)	25	(22–29)	26	(23–31)	26	(23–30)
Sponsor marital status						
Married	127,092	72.7	974,711	93.4	1,159,375	88.9
Not married	47,829	27.3	69,101	6.6[a]	145,031	11.1
Sponsor race/ethnicity						
Non-Hispanic white	83,645	47.8	727,580	69.7	861,810	66.1
Non-Hispanic black	48,519	27.7	122,057	11.7	189,242	14.5
Hispanic	23,855	13.6	113,073	10.8	145,292	11.1
Asian/Pacific Islander	10,903	6.2	47,952	4.6	62,530	4.8
American Indian/Alaska Native	4,076	2.3	17,577	1.7	22,923	1.8
Other/unknown	3,923	2.2	15,573	1.5	22,609	1.7
Sponsor educational attainment						
Less than bachelor's degree	144,755	82.8	791,754	75.9	993,791	76.2
Bachelor's degree or greater	30,166	17.3	252,058	24.2	310,615	23.8
Sponsor branch of service						
Army	60,789	34.8	464,064	44.5	568,571	43.6
Air Force	53,816	30.8	228,178	21.9	300,596	23.0
Navy	46,802	26.8	211,230	20.2	274,577	21.1
Marine Corps	13,514	7.7	140,340	13.4	160,662	12.3
Sponsor pay grade						
E1–E3	38,806	22.2	143,281	13.7	193,721	14.9
E4–E6	107,728	61.6	638,165	61.1	796,103	61.0
E7–E9	4,644	2.7	71,184	6.8	89,262	6.8
O1–O3	16,839	9.6	122,611	11.8	145,039	11.1
O4–O9	6,311	3.6	56,025	5.4	66,049	5.1
W1–W5	592	0.3	12,521	1.2	14,164	1.1
Unknown	1	<0.1	25	<0.1	68	<0.1
Sponsor rank						
Enlisted	151,179	86.4	852,635	81.7	1,079,093	82.7
Officer	23,150	13.2	178,638	17.1	211,090	16.2
Warrant officer	592	0.3	12,521	1.2	14,164	1.1
Unknown	0	0.0	18	<0.1	59	<0.1
Sponsor occupation						
Combat specialist	11,103	6.4	257,773	24.7	279,601	21.4
Healthcare specialist	33,749	19.3	63,932	6.1	104,263	8.0
Other/unknown	130,069	74.4	722,107	69.2	920,542	70.6
Infant birth facility type						
Military	123,267	70.5	434,642	41.6	575,472	44.1
Civilian	51,636	29.5	608,522	58.3	719,326	55.1
Unknown	18	<0.1	648	0.1	9,608	0.7
Infant plurality						
Singleton	172,710	98.7	1,030,603	98.7	1,287,856	98.7
Multiple	2,211	1.3	13,209	1.3	16,550	1.3

SD, standard deviation; IQR, interquartile range

[a]Discrepancy between beneficiary status and marital status due to variations in lag times for status change updates

have less than a college education, and be in a healthcare or other/unknown occupation. Registry live births occurred in all 50 states and the District of Columbia, as well as overseas, with the highest numbers in locations with a greater U.S. military presence (birth location was unknown for 9,608 infants). On average, 100,088 Registry live births occurred annually in the U.S. with the highest numbers of live births in California (11,524), Texas (9,975), Virginia (8,547), and North Carolina (7,972). Internationally, Germany (2,988) and Japan (2,164) had the highest average numbers of Registry live births per year.

Infants born to active duty women

The annual numbers of infants born to active duty women ranged from 13,602 to 15,414 during 2003–2014, with the highest counts among Army women **(Figure 1)**. Women aged 20–24 years had the highest annual numbers of births, although these numbers decreased over time, as did births among women less than 20 years of age **(Figure 2)**. Conversely, births increased among women aged 30 years or older.

The male:female infant sex ratio was consistently greater than 1.0 across all demographic/military groups. Rates of birth defects increased with advancing maternal age, male infant sex, and plurality **(Table 2)**. The overall rate of major birth defects gradually increased between 2003 and 2014, with male infants having higher rates than females **(Figure 3)**. Cardiovascular defects were the most common, followed by genitourinary and musculoskeletal defects **(Figure 4)**. This pattern was apparent among the ten most prevalent individual birth defects diagnosed among infants of active duty mothers **(Table 3)**.

Preterm birth rates were highest among infants born to the youngest (less than 20 years) and oldest (35 years or older) mothers. Rates were also highest among infants born to unmarried mothers and to non-Hispanic black mothers. Similar increases in rates were seen for LBW **(Table 2)**. Annual rates of preterm birth declined between 2003 and 2014 and were higher among male infants. Rates of LBW were relatively stable and higher among female infants **(Figure 5)**.

FIGURE 1. Number of annual live births to active duty U.S. military women, by branch of service, Department of Defense Birth and Infant Health Registry, 2003–2014

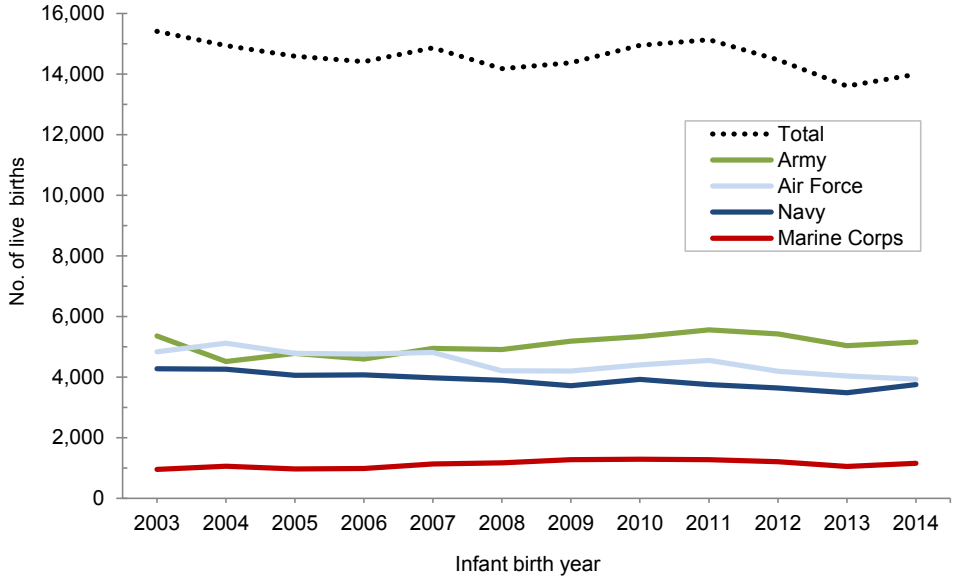
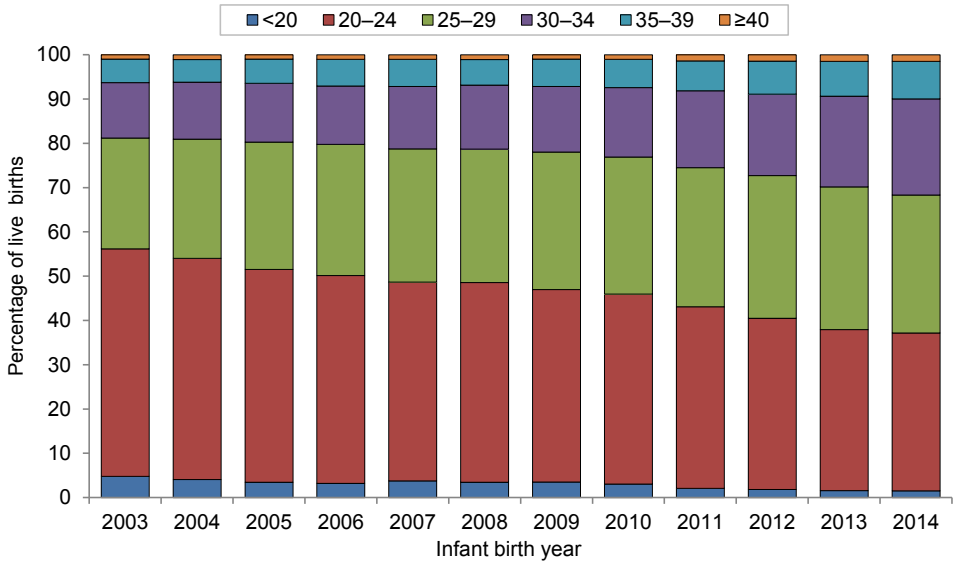


FIGURE 2. Annual distribution of live births, by maternal age at delivery, among infants born to active duty U.S. military women, Department of Defense Birth and Infant Health Registry, 2003–2014



Infants born to dependent spouses and those in the overall Registry

The number of infants born to dependent spouses ranged from 73,665 in 2003 to a high of 97,110 in 2011 **(Figure 6)**. In 2003, nearly 50% of dependent spouses' infants were born in military hospitals. Since then, that proportion has declined to approximately 40% **(Figure 7)**, although the total number of annual births has remained relatively constant **(Figure 6)**. Among infants born to active duty women, approximately 70% were born at military treatment facilities and this proportion has remained stable over time **(Figure 7)**. Trends for all Registry

TABLE 2. Infant outcomes, by maternal and infant characteristics, among infants born to active duty U.S. military women, Department of Defense Birth and Infant Health Registry, 2003–2014

Characteristics	Infant sex			Any birth defect		Preterm birth		Low birth weight	
	Male (M)	Female (F)							
	No.	No.	M:F ratio	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Overall	89,422	85,499	1.05	5,407	3.1	15,714	9.0	9,056	5.2
Maternal age at infant birth									
<20	2,687	2,628	1.02	155	2.9	569	10.7	404	7.6
20–24	39,031	37,586	1.04	2,235	2.9	6,516	8.5	3,862	5.0
25–29	26,952	25,397	1.06	1,624	3.1	4,405	8.4	2,472	4.7
30–34	14,012	13,396	1.05	871	3.2	2,622	9.6	1,426	5.2
35–39	5,683	5,507	1.03	436	3.9	1,300	11.6	706	6.3
≥40	1,057	985	1.07	86	4.2	302	14.8	186	9.1
Maternal marital status									
Married	64,991	62,101	1.05	3,909	3.1	10,989	8.6	6,059	4.8
Not married	24,431	23,398	1.04	1,498	3.1	4,725	9.9	2,997	6.3
Maternal race/ethnicity									
Non-Hispanic white	42,931	40,714	1.05	2,724	3.3	6,560	7.8	3,295	3.9
Non-Hispanic black	24,604	23,915	1.03	1,511	3.1	5,597	11.5	3,712	7.7
Hispanic	12,170	11,685	1.04	692	2.9	1,933	8.1	1,146	4.8
Asian/Pacific Islander	5,589	5,314	1.05	273	2.5	969	8.9	530	4.9
American Indian/Alaska Native	2,112	1,964	1.08	108	2.6	325	8.0	165	4.0
Other/unknown	2,016	1,907	1.06	99	2.5	330	8.4	208	5.3
Maternal education									
Less than bachelor's degree	73,992	70,763	1.05	4,428	3.1	12,917	8.9	7,560	5.2
Bachelor's degree or greater	15,430	14,736	1.05	979	3.2	2,797	9.3	1,496	5.0
Maternal branch of service									
Army	31,019	29,770	1.04	1,877	3.1	5,910	9.7	3,545	5.8
Air Force	27,661	26,155	1.06	1,703	3.2	4,453	8.3	2,420	4.5
Navy	23,955	22,847	1.05	1,430	3.1	4,314	9.2	2,487	5.3
Marine Corps	6,787	6,727	1.01	397	2.9	1,037	7.7	604	4.5
Maternal rank									
Enlisted	77,272	73,907	1.05	4,623	3.1	13,569	9.0	7,900	5.2
Officer	12,150	11,592	1.05	784	3.3	2,145	9.0	1,156	4.9
Maternal occupation									
Combat specialist	5,634	5,469	1.03	346	3.1	970	8.7	573	5.2
Healthcare specialist	17,380	16,369	1.06	1,056	3.1	3,083	9.1	1,737	5.1
Other/unknown	66,408	63,661	1.04	4,005	3.1	11,661	9.0	6,746	5.2
Infant plurality									
Singleton	88,326	84,384	1.05	5,300	3.1	13,687	7.9	7,970	4.6
Multiple	1,096	1,115	-	107	4.8	2,027	91.7	1,086	49.1
Infant sex									
Male	-	-	-	3,112	3.5	8,309	9.3	4,336	4.8
Female	-	-	-	2,295	2.7	7,405	8.7	4,720	5.5

[a]Rates per 100 live births

infants mirror those for infants born to dependent spouses, as the latter comprise the majority of the Registry population.

Table 4 shows male:female infant sex ratios and rates of other outcomes for infants born to dependent spouses and for the Registry overall, by maternal/sponsor and infant characteristics. Similar to infants born to active duty women, the male:female infant sex ratio among infants born to dependent spouses was consistently greater than 1.0 across all groups. Birth defect rates were higher with increasing maternal age, male infant sex, and plurality. Rates of preterm birth and LBW were highest among the youngest (less than 20 years) and oldest (35 years or older) mothers, as well as among infants born to women with unmarried sponsors and non-Hispanic black sponsors. The preterm birth rate was higher among male infants, while the LBW rate was higher among female infants.

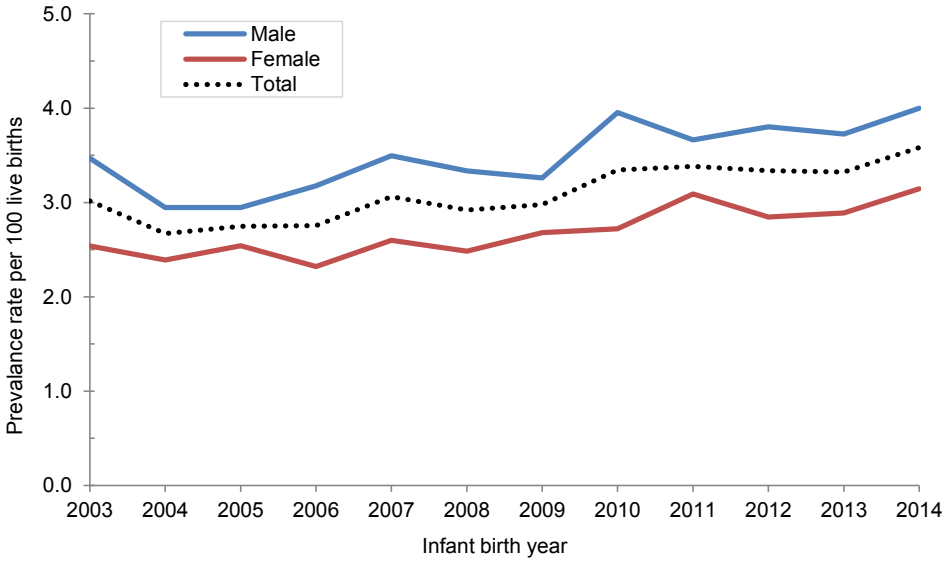
The 10 most prevalent birth defects diagnosed in the infants of all Registry mothers are listed in **Table 3**. This ranking is largely the same as that for infants born to active duty women. Similarly, the most

prevalent birth defects included those that affect the cardiovascular, genitourinary, and musculoskeletal systems.

Pregnancies among active duty women

Approximately 20,000–25,000 pregnancies were identified among active duty women each year between 2003 and 2014. Of these, nearly 70% resulted in a live delivery, 0.3% in a stillbirth, and 16% in another type of pregnancy loss (e.g., spontaneous abortion; **Table 5**). For 14% of pregnancies, an outcome could not be determined. Stillbirth rates were highest among non-Hispanic black women, while rates of other losses were higher among older (≥35 years) and unmarried women **(data not shown)**. Additional details on pregnancy characteristics are provided in **Table 5**.

FIGURE 3. Annual rate of any major birth defect, by infant sex, among infants born to active duty U.S. military women, Department of Defense Birth and Infant Health Registry, 2003–2014



EDITORIAL COMMENT

On average, there were 108,700 infants born annually to military families and included in the Registry during 2003–2014. Active duty women contributed an average of approximately 14,600 infants annually to the Registry. Although the numbers of such infants were lowest in 2013 and 2014, the overall trend was relatively stable during the surveillance period. Births to dependent spouses increased by an average of 3.5% annually from 2003–2011, then decreased by an average of 2.5% in 2012 and 2013 before leveling off in 2014.

The observed trends in maternal age of active duty women, and in all women in the Registry overall **(data not shown)**, with progressively fewer births to younger mothers and more to older mothers, mirrored what has been reported previously for the DoD population and for the general U.S. population.[4-6] Other characteristics of active duty mothers, such as race/ethnicity, service branch, and military rank, were also similar to previous reports.[4]

In this descriptive overview, rates of adverse infant outcomes across all Registry populations were comparable to or lower than those seen in the general U.S. population.[5,7] This observation is likely due to the younger and healthier nature of U.S. service members and their dependents. Distributions by maternal age and race/ethnicity were also comparable: birth defect rates were highest for infants born to non-Hispanic white mothers/sponsors and women aged 35 years or older;[7] preterm birth and LBW rates were higher among infants born to non-Hispanic black mothers/sponsors as well as younger (less than 20 years) and older (35 years or older) mothers.[7,8]

The birth defect rate among infants born to active duty women, and to Registry mothers overall, increased almost 20% between 2003 and 2014. This increase may

FIGURE 4. Distribution of birth defects, by organ system, among infants born to active duty U.S. military women, Department of Defense Birth and Infant Health Registry, 2003–2014

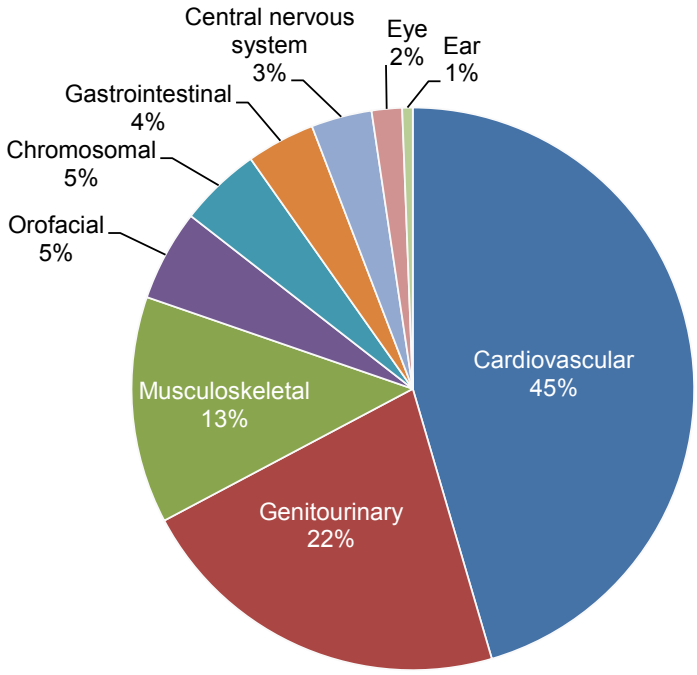
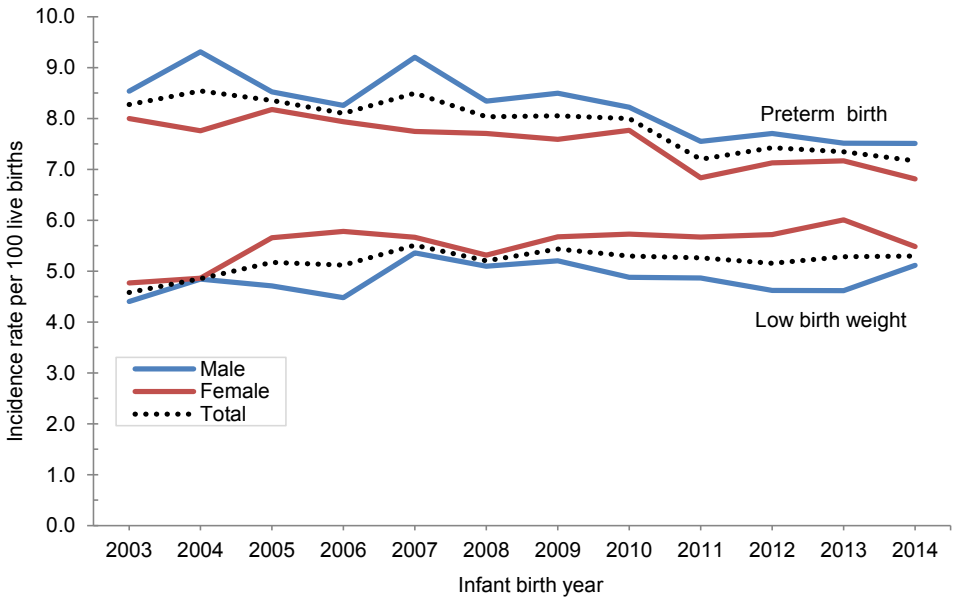


TABLE 3. Most prevalent birth defects among infants, Department of Defense Birth and Infant Health Registry, 2003–2014

Birth defect	Organ system	Rate per 10,000 live births
Infants born to active duty mothers		
Hypospadias[a]	Genitourinary	110.0
Atrial septal defect	Cardiovascular	87.2
Ventricular septal defect	Cardiovascular	66.7
Clubfoot	Musculoskeletal	20.1
Pulmonary valve atresia/stenosis	Cardiovascular	17.7
Down syndrome	Chromosomal	11.3
Cloacal exstrophy	Genitourinary	10.7
Cleft palate without cleft lip	Orofacial	10.1
Coarctation of the aorta	Cardiovascular	9.2
Tetralogy of Fallot	Cardiovascular	7.6
Infants born to all Registry mothers		
Hypospadias[a]	Genitourinary	102.4
Atrial septal defect	Cardiovascular	91.8
Ventricular septal defect	Cardiovascular	68.4
Clubfoot	Musculoskeletal	21.2
Pulmonary valve atresia /stenosis	Cardiovascular	16.6
Down syndrome	Chromosomal	14.1
Cleft palate alone	Orofacial	11.4
Coarctation of the aorta	Cardiovascular	9.3
Cloacal exstrophy	Genitourinary	8.5
Cleft lip with cleft palate	Orofacial	8.0

[a]Rate among male infants only

FIGURE 5. Annual rates of preterm birth and low birth weight, by infant sex, among infants born to active duty U.S. military women, Department of Defense Birth and Infant Health Registry, 2003–2014



be explained, at least in part, by increased detection with improved diagnostic technology/testing over time. This phenomenon has been observed previously and described in other populations.[9,10] However, it is possible that real increases in the prevalence of certain individual defects (e.g., gastroschisis) could also contribute to this trend.[11]

Rates of preterm birth have declined between 2003 and 2014 among both infants born to active duty women and in the Registry population overall. This decline has also been reported for the general U.S. population and attributed to a decreased proportion of births among younger mothers.[8] It has also been suggested that increased awareness of risks associated with late preterm delivery have led to increased efforts to reduce non-medically indicated deliveries before completion of 39 weeks of gestation.[5] Notably, an increase in preterm births has been observed in the general population between 2014 and 2015. Future investigations will determine whether this trend is apparent in the Registry population.[5] The rates of LBW peaked in 2007 among infants born to active duty women and in 2008 in the Registry population overall, and declined slightly thereafter. A similar trend has been observed in the general U.S. population.[5]

On average, there were 21,500 pregnancies among active duty women each year between 2003 and 2014. Seventy percent of pregnancies resulted in a live birth, while 0.3% and 16% resulted in a stillbirth or other pregnancy loss, respectively. These Registry pregnancy outcome rates are generally comparable to previous reports for the military beneficiary population,[12] as well as to the general U.S. population,[13,14] with the exception of a lower stillbirth rate. The lower rate of stillbirths is likely due to the Registry's conservative case definition.

Building on the descriptive findings in this report, analyses of Registry data have assessed a number of specific exposures of concern and found reassuring results based on the lack of associations with adverse reproductive outcomes. These studies include assessments of inadvertent exposure to smallpox vaccine,[15-17] and/or anthrax vaccine,[18,19] as well as influenza A/H1N1[20] vaccination in pregnancy among

FIGURE 6. Number of annual live births, in total and at military treatment facilities (MTFs), by maternal beneficiary type, Department of Defense Birth and Infant Health Registry, 2003–2014

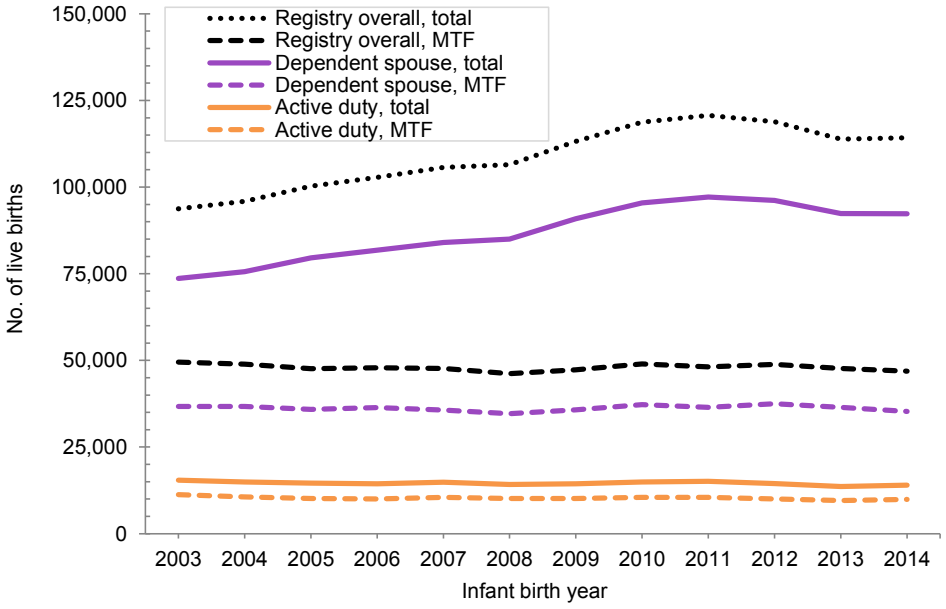
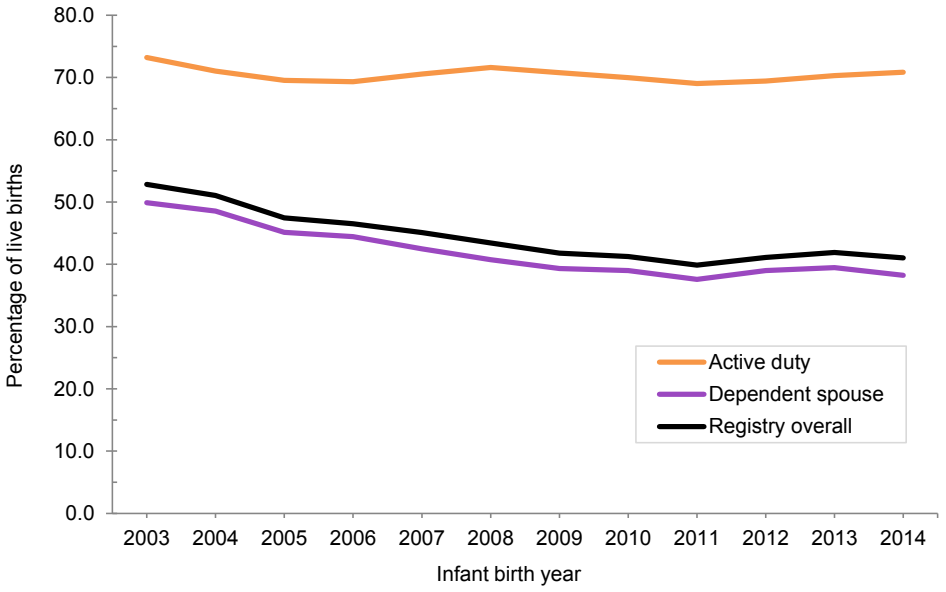


FIGURE 7. Annual percentages of infants born at military treatment facilities, by maternal beneficiary type, Department of Defense Birth and Infant Health Registry, 2003–2014



military women and their possible associations with adverse reproductive health outcomes, including infertility, pregnancy loss, preeclampsia, preterm labor and birth, as well as birth defects. Analyses of Registry data have also assessed risks for birth defects and preterm birth among infants of active duty women and men who were deployed within 3 miles of an open-air burn pit before the start of their infant's gestation, or additionally during pregnancy for women,[21] risks for adverse infant health outcomes among infants born to women who were inadvertently deployed to military operations during pregnancy,[22] and long-term risks for birth defects among infants born to service men and women deployed to the 1990–1991 Gulf War.[23]

Registry data have also been used to assess a variety of outcomes outside of reproductive health. One study evaluated rates of and risk factors for abusive head trauma among infants born to military families.[24] Another assessed the relationship between timing of spousal deployment relative to pregnancy and postpartum depression among wives of U.S. military service members.[25] More recently, a study was performed to assess and identify predictors of suboptimal postpartum fitness and weight outcomes among active duty Navy women,[26] which led to policy changes in the Navy Physical Readiness Program.[27]

The aforementioned studies are just a sample of the Registry's diverse research portfolio, which also includes the National Smallpox Vaccine in Pregnancy Registry and the BioThrax® (Anthrax) Vaccine in Pregnancy Registry. Both demonstrate the Registry's unique capabilities to answer a wide range of questions relating to maternal and infant health, including those of specific military relevance and broader interest. The Registry is currently expanding to include all pregnancies, including those not ending in live deliveries, among dependent spouses of military service members. This effort will enhance capabilities for assessing pregnancy exposures and outcomes, especially those that are less common. Another recent enhancement of the Registry is the capability to follow infants through early childhood and to assess pediatric outcomes beyond the first year of life, such as childhood cancers and developmental disorders.

As reflected by the wide variety of studies using Registry data, reproductive health is a broad discipline that covers topics from infertility, through maternal and pregnancy outcomes, to infant and child health. Registry analyses focus primarily on outcomes following exposures of potential concern. As such, evaluating maternal, pregnancy, and infant outcomes among female service members and their infants is essential because the possible effects of such exposures would likely be heightened in this group. Furthermore, with increasing numbers of women serving in the military, particularly those of childbearing age, and their broadening occupational roles,

TABLE 4. Outcomes among infants born to dependent spouses and in the Department of Defense Birth and Infant Health Registry overall, 2003–2014

	Dependent spouses (N=1,043,812)				Registry overall (N=1,304,406)			
Characteristic	M:F infant sex ratio	Any birth defect %	Preterm birth %	Low birth weight %	M:F infant sex ratio	Any birth defect %	Preterm birth %	Low birth weight %
Overall	1.06	3.2	9.0	4.3	1.06	3.1	9.0	4.5
Maternal age at infant birth (years)								
<20	1.06	3.0	9.4	5.2	1.06	2.7	9.6	5.2
20–24	1.06	3.0	8.6	4.3	1.06	3.0	8.6	4.4
25–29	1.06	3.1	8.4	3.9	1.06	3.1	8.4	4.1
30–34	1.05	3.2	9.1	4.3	1.05	3.2	9.2	4.4
35–39	1.05	3.8	11.3	5.3	1.05	3.8	11.3	5.4
≥40	1.07	4.8	14.0	7.2	1.07	4.8	14.2	7.5
Unknown	-	-	-	-	1.09	3.1	9.4	5.4
Sponsor marital status								
Married	1.06	3.2	9.0	4.3	1.06	3.1	9.0	4.4
Not married	1.06	3.1	9.5	5.0	1.06	3.1	9.5	5.5
Sponsor race/ethnicity								
Non-Hispanic white	1.06	3.3	8.8	4.0	1.06	3.2	8.7	4.0
Non-Hispanic black	1.04	3.0	11.0	6.4	1.04	3.0	11.2	6.8
Hispanic	1.05	2.9	8.5	4.3	1.05	2.9	8.4	4.4
Asian/Pacific Islander	1.07	2.7	8.5	4.8	1.07	2.7	8.6	4.8
American Indian/Alaska Native	1.02	3.0	8.8	4.1	1.03	2.9	8.7	4.1
Other/unknown	1.07	3.2	9.1	4.7	1.06	2.9	9.1	4.8
Sponsor education								
Less than bachelor's degree	1.06	3.1	9.1	4.5	1.06	3.1	9.1	4.6
Bachelor's degree or greater	1.05	3.3	8.7	3.9	1.06	3.3	8.9	4.1
Sponsor branch of service								
Army	1.05	3.2	9.2	4.5	1.06	3.1	9.3	4.7
Air Force	1.05	3.2	8.4	3.8	1.06	3.2	8.4	4.0
Navy	1.06	3.2	9.4	4.5	1.06	3.1	9.4	4.7
Marine Corps	1.06	3.0	8.8	4.3	1.06	2.9	8.7	4.3
Sponsor rank								
Enlisted	1.06	3.2	9.2	4.5	1.06	3.1	9.2	4.6
Officer	1.06	3.2	8.1	3.5	1.06	3.2	8.3	3.7
Unknown	1.57	11.1	11.1	11.1	1.46	6.8	6.8	3.4
Sponsor occupation								
Combat specialist	1.06	3.1	8.6	4.0	1.06	3.1	8.7	4.1
Healthcare specialist	1.06	3.1	9.0	4.4	1.06	3.1	9.0	4.6
Other/unknown	1.06	3.2	9.1	4.4	1.06	3.1	9.1	4.6
Infant birth year								
2003	1.04	2.9	9.1	4.1	1.04	2.9	9.1	4.2
2004	1.06	2.9	9.6	4.3	1.05	2.8	9.6	4.4
2005	1.05	3.0	9.4	4.3	1.05	2.9	9.5	4.5
2006	1.06	3.1	9.5	4.3	1.06	3.0	9.5	4.5
2007	1.05	3.1	9.4	4.4	1.05	3.0	9.5	4.6
2008	1.06	3.1	9.4	4.5	1.06	3.1	9.4	4.6
2009	1.06	3.1	9.2	4.4	1.06	3.1	9.2	4.6
2010	1.06	3.2	9.0	4.3	1.05	3.2	9.0	4.5
2011	1.06	3.3	8.8	4.4	1.06	3.3	8.8	4.5
2012	1.05	3.3	8.5	4.4	1.06	3.3	8.5	4.5
2013	1.07	3.5	8.2	4.3	1.07	3.4	8.3	4.5
2014	1.06	3.3	8.0	4.3	1.06	3.4	8.1	4.4
Infant sex								
Male	-	3.6	9.4	4.1	-	3.5	9.4	4.3
Female	-	2.7	8.6	4.6	-	2.7	8.6	4.7
Infant plurality								
Singleton	1.06	3.1	7.9	3.8	1.06	3.1	8.0	4.0
Multiple	-	4.5	91.3	42.2	-	4.4	91.3	43.1

M, male; F, female

TABLE 5. Pregnancies and outcomes among active duty U.S. military women, 2003–2014

Characteristics	All pregnancies		Live deliveries		Stillbirths		Other losses[a]		Unknown outcomes	
	No.	%	No.	%	No.	%	No.	%	No.	%
Overall	258,332		180,044[b]	69.7	768	0.30	41,278	16.0	36,242	14.0
Maternal age at pregnancy end (years)										
<20	7,935	3.1	5,405	3.0	27	3.5	1,256	3.0	1,247	3.4
20–24	110,817	42.9	78,608	43.7	348	45.3	16,208	39.3	15,653	43.2
25–29	75,898	29.4	54,013	30.0	214	27.9	11,593	28.1	10,078	27.8
30–34	40,210	15.6	28,406	15.8	114	14.8	6,658	16.1	5,032	13.9
35–39	18,418	7.1	11,547	6.4	55	7.2	3,960	9.6	2,856	7.9
≥40	5,054	2.0	2,065	1.1	10	1.3	1,603	3.9	1,376	3.8
Mean (SD)	26.3	(5.3)	26.0	(5.0)	25.9	(5.3)	27.0	(5.9)	26.5	(5.9)
Median (IQR)	25	(22–29)	25	(22–29)	25	(22–29)	26	(22–31)	25	(22–30)
Maternal marital status										
Married	177,436	68.7	131,347	73.0	487	63.4	25,893	62.7	19,709	54.4
Not married	80,896	31.3	48,697	27.0	281	36.6	15,385	37.3	16,533	45.6
Maternal race/ethnicity										
Non-Hispanic white	121,727	47.1	86,711	48.2	276	35.9	19,107	46.3	15,633	43.1
Non-Hispanic black	74,169	28.7	49,118	27.3	339	44.1	12,206	29.6	12,506	34.5
Hispanic	34,683	13.4	24,406	13.6	76	9.9	5,664	13.7	4,537	12.5
Asian/Pacific Islander	15,520	6.0	11,123	6.2	43	5.6	2,310	5.6	2,044	5.6
American Indian/Alaska Native	5,832	2.3	4,193	2.3	12	1.6	890	2.2	737	2.0
Other/unknown	6,401	2.5	4,493	2.5	22	2.9	1,101	2.7	785	2.2
Maternal education										
Less than bachelor's degree	214,324	83.0	148,688	82.6	661	86.1	34,023	82.4	30,952	85.4
Bachelor's degree or greater	44,008	17.0	31,356	17.4	107	13.9	7,255	17.6	5,290	14.6
Maternal branch of service										
Army	93,489	36.2	60,415	33.6	280	36.5	16,439	39.8	16,355	45.1
Air Force	74,843	29.0	53,997	30.0	227	29.6	11,666	28.3	8,953	24.7
Navy	65,838	25.5	47,891	26.6	203	26.4	9,686	23.5	8,058	22.2
Marine Corps	18,663	7.2	13,761	7.6	46	6.0	2,682	6.5	2,174	6.0
Other/unknown	5,499	2.1	3,980	2.2	12	1.6	805	2.0	702	1.9
Maternal rank										
Enlisted	224,245	86.8	155,426	86.3	696	90.6	35,786	86.7	32,337	89.2
Officer	34,087	13.2	24,618	13.7	72	9.4	5,492	13.3	3,905	10.8
Maternal occupation										
Combat specialist	16,648	6.4	11,647	6.5	44	5.7	2,536	6.1	2,421	6.7
Healthcare specialist	47,916	18.5	34,120	19.0	124	16.1	7,773	18.8	5,899	16.3
Other/unknown	193,768	75.0	134,277	74.6	600	78.1	30,969	75.0	27,922	77.0
Pregnancy end year										
2003	24,746	9.6	16,101	8.9	88	11.5	3,426	8.3	5,131	14.2
2004	22,869	8.9	15,511	8.6	76	9.9	3,262	7.9	4,020	11.1
2005	21,234	8.2	14,888	8.3	76	9.9	2,891	7.0	3,379	9.3
2006	21,251	8.2	14,796	8.2	81	10.5	3,276	7.9	3,098	8.5
2007	21,881	8.5	15,303	8.5	68	8.9	3,578	8.7	2,932	8.1
2008	21,176	8.2	14,555	8.1	56	7.3	3,662	8.9	2,903	8.0
2009	21,357	8.3	14,815	8.2	56	7.3	3,710	9.0	2,776	7.7
2010	21,859	8.5	15,352	8.5	63	8.2	3,784	9.2	2,660	7.3
2011	21,723	8.4	15,566	8.6	52	6.8	3,494	8.5	2,611	7.2
2012	20,897	8.1	14,885	8.3	47	6.1	3,482	8.4	2,483	6.9
2013	19,536	7.6	14,054	7.8	54	7.0	3,313	8.0	2,115	5.8
2014	19,803	7.7	14,218	7.9	51	6.6	3,400	8.2	2,134	5.9

SD, standard deviation; IQR, interquartile range

[a]Pregnancies with indication of elective abortion were excluded from reporting.

[b]Not all live deliveries are included in the Registry's infant population due to standard exclusions.

leveraging Registry data to evaluate reproductive outcomes within this population will provide the military community with necessary information to identify successes and areas for potential improvement in prevention and care.

Inquiries and collaboration requests may be directed to the DoD Birth and Infant Health Registry either by phone (619-553-9255) or email (DOD.NHRC-BirthRegistry@mail.mil).

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Acknowledgments: The authors thank the additional team members of the Department of Defense Birth and Infant Health Registry: Susan C. Farrish, MD, MPH, and Katherine J. Snell, as well as Claire A. Kolaja, MPH, for her expert assistance in the geographic assessment of Registry data. The team gratefully acknowledges the support of the DMDC.

Report No. 17-102 was supported by the Navy Bureau of Medicine and Surgery under work unit no. 60504. The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of the Army, Department of the Air Force, Department of Veterans Affairs, Department of Defense, or the U.S. Government. Approved for public release; distribution unlimited.

Informed consent was waived in accordance with 32 CFR §219.116(d). This research has been conducted in compliance with all applicable federal regulations governing the protection of human subjects in research (Protocol NHRC.1999.0003).

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Department of Defense Birth and Infant Health Registry

Increasing the understanding of how military service affects service members' reproductive health

Health Surveillance

- Maternal and pregnancy outcomes (including losses)
- Infant outcomes (including birth defects)

100K

Births annually
to DoD beneficiaries

Service members and dependents

13%

Infants born to
Active Duty mothers

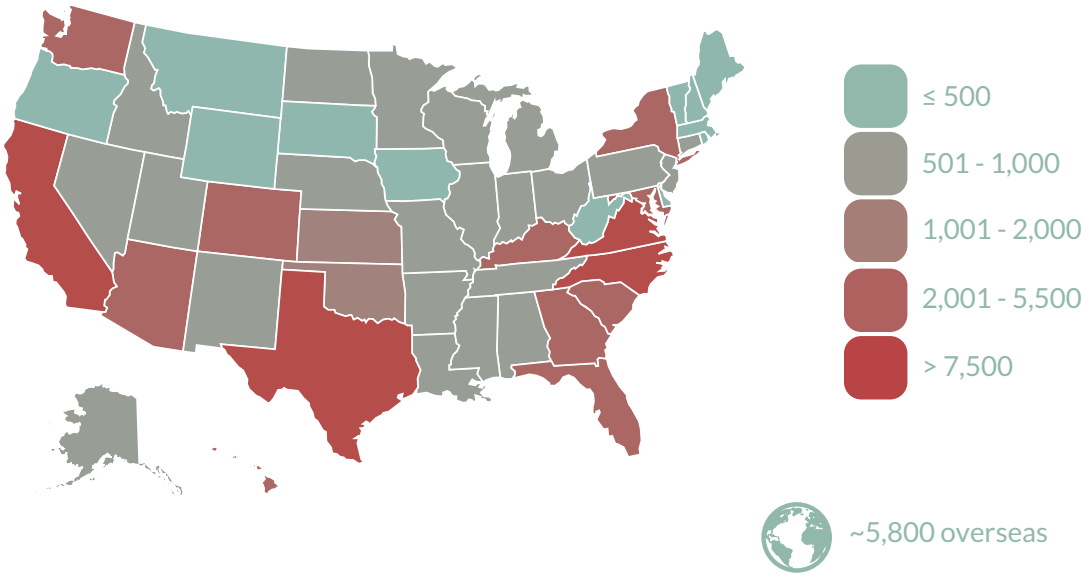
Approximately 14,600 per year

1.8M

Infants
in the Registry

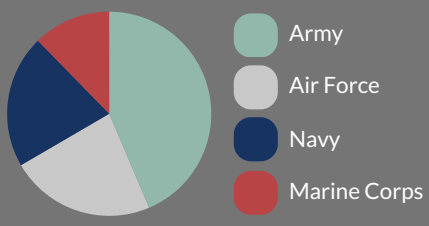
Followed through first year of life

Average number of annual births 2003 - 2014



~5,800 overseas

Births by service branch



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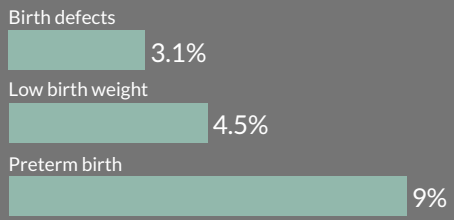
Infant outcome rates*



*Rates are comparable to non-military populations

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ISSN 2158-0111 (print)
ISSN 2152-8217 (online)