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Association of Age and Parity With Intrauterine Device Expulsion

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Abstract

Objective—To investigate whether age 14–19 years and nulliparity are associated with expulsion of the levonorgestrel and copper intrauterine devices (IUD).

Methods—This was a planned secondary analysis of the Contraceptive CHOICE Project. We used Kaplan-Meier survival analysis to estimate expulsion rates for the first levonorgestrel or copper IUD received during study participation. Cox proportional hazards regression models were used to investigate baseline characteristics associated with expulsion.

Results—A total of 5,403 females were included; 4,219 (78%) levonorgestrel IUD and 1,184 (22%) copper IUD users. There were 432 initial expulsions reported. The 36-month cumulative expulsion rate was 10.2 per 100 IUD users and did not vary by IUD type (levonorgestrel IUD 10.1 vs. copper IUD 10.7, $p=0.99$). In the bivariate analysis, multiple characteristics including age, nulliparity, immediate postabortion insertion, and heavy menses were associated with expulsion. The cumulative rate of expulsion was lower in nulliparous women compared to parous women (8.4 vs. 11.4, $p<.001$) and higher in females aged 14–19 compared to older women (18.8 vs. 9.3, $p<.001$). After adjusting for confounders and stratifying by IUD type, the hazards ratio (HR_{adj}) of expulsion for females aged 14–19 years was 2.26 (95% CI 1.68–3.06) for the levonorgestrel IUD and 3.06 (95% CI 1.75–5.33) for the copper IUD. Compared to parous levonorgestrel IUD users, expulsion was lower for nulliparous levonorgestrel IUD users (HR_{adj} 0.59, 95% CI 0.44–0.78).

Conclusions—IUD expulsions were not increased in nulliparous females. More expulsions were observed in females aged 14–19 compared to older women regardless of parity or IUD type.

Increased use of the intrauterine device (IUD), has the potential to reduce unintended pregnancy.(1) IUDs have numerous advantages including high rates of effectiveness, safety, and long duration of use.(2,3) First-year expulsion rates of the IUD are commonly quoted as 2–10% and vary by IUD type. (4–7) A large randomized trial of parous women aged 18 to

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38 assigned to the 20 mcg-releasing levonorgestrel intrauterine system or the copper T380Ag IUD observed highest rates of expulsion in the first year of use; 6.3 vs. 5.6 per 100 women, respectively.(5) Over 5 years, the cumulative rate of expulsion was higher with the levonorgestrel IUD compared to the copper T380Ag; 11.8 and 7.4 per 100 users, respectively.

Previously described risk factors for expulsion include age less than 20 years, nulliparity, dysmenorrhea, menorrhagia, and immediate postabortion and postpartum placement.(4,8–10) A systematic review of copper IUD use by nulliparous women found that nulliparity was associated with an increased risk of expulsion.(7) Several other studies have found no increase in the risk of expulsion in nulliparous compared to parous women.(6,11,12) Multiple studies have demonstrated an increased risk of expulsion in adolescents, although most have been limited by a small sample size.(8,12–14)

The objective of this analysis was to measure cumulative expulsion rates in users of both the levonorgestrel IUD (20 mcg/day) and the copper IUD (T380A) and to investigate whether adolescent age (14 to 19) and nulliparity were associated with higher rates of expulsion.

MATERIALS & METHODS

This study was a planned secondary analysis of the Contraceptive CHOICE Project. The CHOICE Project was a prospective cohort study of 9,256 adolescents and women who were provided with the reversible contraceptive method of choice at no cost. The objectives of the CHOICE Project were to reduce unintended pregnancy by promoting the use of long-acting reversible contraceptive (LARC) methods. The methods of this study have been described in detail previously.(15)

Adolescents and women were enrolled between August 2007 and September 2011 and were eligible to participate if they were 14–45 years of age, resided in St. Louis City or County, had been sexually active with a male partner in the past 6 months or anticipated sexual activity in the next 6 months, had not had a tubal sterilization or hysterectomy, did not desire pregnancy in the next year, and were interested in starting a new reversible contraceptive method. Participants completed follow-up surveys by telephone at 3 and 6 months and every 6 months for the study duration (3 years for the first 5090 participants, 2 years for the remaining cohort). Follow-up was completed by December of 2013. We obtained approval from the Washington University in St. Louis School of Medicine Human Research Protection Office prior to recruitment of participants.

Participants were eligible for inclusion in this analysis if they received a levonorgestrel or copper IUD at any time during study participation. Forty-four females who participated in a sub-study investigating immediate postplacental IUD placement were excluded from this analysis, as expulsion rates after immediate postplacental IUD insertion have been shown to be as high as 24%.(10,16) The outcome of interest was the initial expulsion that occurred – meaning the expulsion of the first IUD a participant received which occurred during the study period. Both partial and complete expulsions were included in the outcome. Data about IUD expulsion was collected by follow-up telephone surveys and other participant

contact such as in-person visits to the study clinic or telephone calls to research staff. When the date of IUD expulsion was unknown or not reported, participants' charts were reviewed and consensus was reached on a range of possible dates the expulsion could have occurred (T.M. and D.L.E.). The date of expulsion was then randomly imputed using this range.

We compared the baseline demographic and reproductive characteristics of IUD users by expulsion occurrence using the chi-square tests. Using the Kaplan-Meier survival function, we estimated rates of cumulative expulsion at 3, 6, 12, 24, and 36 months. Females were censored at the time of IUD removal or the date of last study contact. We then compared cumulative expulsions rates for selected baseline characteristics, including age 14 to 19 years and nulliparity (both measured at the time of study enrollment). We used the log-rank test to determine if there was a statistically significant difference in the overall rates. To investigate interactions between baseline covariates of interest, we conducted stratified analyses between IUD type, age group, and parity.

We performed univariable and multivariable Cox proportional hazards regressions to estimate the hazards ratio (HR) for characteristics associated with expulsion. We planned to include adolescent age and nulliparity in the multivariable model regardless of whether it was significant in the univariable model because this was our *a priori* hypothesis. Given our *a priori* hypotheses and prior studies, we planned to include adolescent age, nulliparity, and immediate postabortion placement in our multivariable model, regardless of statistical significance.⁽⁹⁾ All covariates that altered the HR for age 14–19 or nulliparity by 10% or greater were included in the multivariable model. We included an interaction term for age (14–19 years versus >19 years) and nulliparity (yes/no) and one for IUD type and nulliparity. The former was not significant in the univariable or adjusted regression and thus was not included in the final model. We found a significant interaction between IUD type and nulliparity, and therefore stratified our adjusted Cox proportional hazards model by IUD type. In order to create a more parsimonious model, we collapsed the categorical race and marital status variables to dichotomous (black vs. white/other race and married/living with partner vs. single/separated/divorced/widowed). Multicollinearity was checked and the proportional hazards assumption was tested in the final model. We performed all statistical analyses using STATA 11 (StataCorp, College Station, TX).

We performed a *post hoc* power calculation to ensure that we had an adequate sample size to detect a significant difference in expulsion rates. Based on prior studies, we assumed that there would be a two-fold increase in the hazard ratio of expulsion for both nulliparous females and females age 14–19 (HR = 2.0). Assuming a type 1 error of 0.05 and 80% power, we required a total of 65 expulsions to observe a statistically significant difference between groups. We had a total of 432 expulsions; therefore, we were powered to detect the difference in expulsion rates by age or by parity. When stratified by IUD types, we had 339 expulsions for the levonorgestrel IUD and 93 expulsions for the copper IUD and therefore, also had an adequate sample to detect the two-fold difference in the stratified analysis.

RESULTS

There were 5,403 females who received an initial IUD through the CHOICE Project; 4,219 (78%) received a levonorgestrel IUD and 1,184 (22%) received a copper IUD. The mean follow-up time was 22.6 $\pm$ 11 months. There were 64 (1%) females who provided no follow-up data. These women were more likely to have a high school education or less, be separated, divorced or widowed, have no insurance or public insurance, have higher parity, and have received an immediate postabortion IUD. There were 2,182 nulliparous females (40%) and 529 participants between 14–19 years of age (10%) in our cohort. Females aged 14–19 years were more likely to be nulliparous than parous, 69% versus 31% ($p < .001$). The baseline characteristics by expulsion status are shown in Table 1. Females who had expulsions differed from those who did not have expulsions by age, race, education, insurance status, socioeconomic status, body mass index (BMI), nulliparity, history of self-reported heavy periods, and immediate postabortion insertion. There was no difference in expulsion by type of IUD.

There were a total of 432 initial expulsions for a cumulative expulsion rate of 10.2 per 100 IUD users over the 36-month study period. Table 2 shows the cumulative expulsion rates for the study population overall as well as stratified by selected baseline characteristics. The expulsion rates were higher in parous women, women less than 20 years of age, obese participants (BMI ≥ 30), those who underwent an immediate postabortion insertion, and those with self-reported heavy menses – this was also true for cumulative expulsion rates at every time point. The rate of expulsion did not vary by IUD type. Figures 1 and 2 show the Kaplan-Meier curve for the cumulative probability of not having an expulsion for females aged 14 to 19 years compared to 20 to 45 years and nulliparous compared to parous females.

When stratified by parity (Table 3), the cumulative expulsion rate at 36 months was similar among nulliparous and parous 14–19 year-olds (18.7 per 100 versus 18.9 respectively; $p=0.47$). However, the 95% confidence intervals around these estimates are wide, likely reflecting the small number of participants included in the numerator and the denominator.

We found that IUD type acted as an effect modifier for the association of parity and expulsion. The rate of expulsion was lower among nulliparous levonorgestrel IUD users compared to parous users, 6.9 versus 12.2 per 100 users ($p < .001$). Whereas, the rate of expulsion was higher among nulliparous copper IUD users compared to parous users, 14.3 versus 8.2, although this finding among copper IUD users did not reach statistical significance ($p=0.10$). These results are shown in Table 4. Similar proportions of nulliparous and parous females chose the copper IUD, 22.6% versus 21.5%.

In the univariable Cox proportional hazards regression analysis (Table 5), multiple baseline characteristics were associated with an increased risk of expulsion including age 14 to 19 years, black race, obesity, high school education, public insurance, low socioeconomic status, self-reported heavy menses, and immediate postabortion insertion. Having a college-level education, being married or living with a partner, and nulliparity were associated with a decreased risk of expulsion (data not shown). We did find a statistically significant interaction between nulliparity and IUD type in the univariable model. After stratifying the

adjusted proportional hazards model by IUD type, age 14 to 19, remained associated with a greater than 2-fold increase in expulsion for both levonorgestrel IUD and copper IUD users (HR_{adj} 2.26; 95%CI 1.68–3.06, and HR_{adj} 3.06; 95%CI 1.75–5.33 respectively). Heavy periods were also associated with an increased risk of expulsion among users of both types of IUDs. Nulliparity was associated with a reduction in expulsion among levonorgestrel IUD users, but not among copper IUD users. Black race was associated with a slight increase in the risk of expulsion among levonorgestrel IUD users but not copper IUD users.

DISCUSSION

This analysis describes the cumulative 36-month rates of expulsion of the two most commonly used IUDs among a large cohort of U.S. adolescents and women. Expulsions were increased among females age 14–19 regardless of parity and IUD type. We did not observe any increased risk in expulsion among nulliparous participants. In fact, we found that nulliparity was associated with fewer expulsions among levonorgestrel IUD users although not in copper IUD users.

Unlike the Sivin study, we found similar cumulative expulsion rates between the two types of IUDs. Our 36-month cumulative expulsion rate for the levonorgestrel IUD of 10.1 per 100 is similar to the rate reported in the Sivin paper. However, our 36-month cumulative expulsion rate for the copper T 380A of 10.7 per 100 is higher than the 7.1 reported for the copper T 380Ag.(5) When stratified by parity, our expulsion rate for parous copper IUD users was 8.2, similar to the rate published by Sivin et al. Differences in our findings may be due to different study populations; the Sivin study was a randomized controlled trial with selective inclusion criteria and included only parous women aged 18 to 35 years, whereas the CHOICE Project was a cohort study with minimal eligibility criteria which include over 500 adolescents and over 2,000 nulliparous women.

A prior study of two lower-dose levonorgestrel IUDs found a cumulative 3-year risk of expulsion of 3.6–4.6% although the authors did not stratify by parity.(17) While this percentage is lower than our reported rate, women less than 18 years of age were not included and the IUDs were smaller than those included in our study. A recent retrospective cohort study published in *Obstetrics and Gynecology* found an expulsion rate of 6% over 3 years.(18) This is lower than our rate, in part because this 6% does not incorporate time-to-event but rather is a direct proportion. The investigators also did not find a significantly higher rate of expulsion among women aged 14–19, but this may be due to their smaller sample of adolescents (n=249).

We were not surprised to observe a greater rate of expulsion after immediate postabortion IUD insertion as prior studies have demonstrated this increase in risk.(9) Despite this slight increase in the risk of expulsion, immediate postabortion IUD insertion has been shown to be cost effective (19) and to decrease the risk of a subsequent unintended pregnancy.(20) While the expulsion rates in our immediate postabortion group reflect females who had undergone first- and second-trimester surgical abortion procedures, our 6-month rates are similar to the 6-month expulsion rates published by Bednarek et al of 5.0% after immediate postabortion insertion and 2.7% after interval insertion.(21)

The strengths of our study include its prospective cohort design, our large cohort of IUD users, and high retention among study participants. The 3, 6, 12, 24, and 36-month follow-up rates in the CHOICE Project were 98%, 97%, 95%, 86%, and 81% respectively. We captured data about expulsion at multiple contact points including scheduled telephone surveys, unscheduled telephone calls to study staff, and visits to our research clinic.

One limitation of this study is that we relied on participant self-report to determine expulsion. Therefore, it is possible that we are underestimating the true incidence of expulsion if the participant did not recognize the expulsion or did not report it to the study staff. Another potential limitation is the lack of detail about partial versus complete expulsions. If some clinicians performed routine ultrasounds and considered an IUD positioned low in the uterus to be a “partial expulsion,” this could have artificially elevated our expulsion rate. Lastly, our findings may not be generalizable to other populations as the CHOICE Project was limited to a single geographical region. However, our cohort was racially and socioeconomically diverse with a large number of nulliparous and adolescent and young women IUD users, and our findings likely are applicable to other urban populations.

The higher incidence of expulsion observed among females aged 14–19 years should not discourage healthcare providers from recommending IUDs for this population. The American College of Obstetricians and Gynecologists has recommended IUDs and implants as first-line contraceptive options for teenagers.(22) IUDs have few contraindications and in most situations the advantages outweigh the risks.(23) Furthermore, the observed risk of expulsion is lower than the risk of discontinuation with a shorter-acting method such as oral contraceptives or depo-medroxyprogesterone.(24) The higher risk of IUD expulsion in teenagers and women with heavy periods should be included at the time of contraceptive counseling, but should not restrict IUD use in these populations.

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Figure 1.
Cumulative probability of not having an intrauterine device expulsion stratified by age.

Figure 2.
Cumulative probability of not having an intrauterine device expulsion stratified by parity.

Baseline Demographic and Reproductive Characteristics of Intrauterine Device Users by whether an Expulsion Occurred.

Table 1

	No IUD Expulsion (n=4,971)		IUD Expulsion (n=432)		P value
	N	%	N	%	
Age					<.001
	14–19	452	9.1	17.8	
	20–29	3261	65.6	59.7	
	30–45	1258	25.3	22.5	
Race					<.001
	Black	2222	44.7	57.6	
	White	2375	47.8	35.7	
	Other	374	7.5	6.7	
Hispanic ethnicity					0.91
	Yes	248	5.0	4.9	
Education (missing, n = 1)					<.001
	High school	1462	29.4	38.7	
	Some college	2165	43.6	44.9	
	College+	1343	27.0	16.4	
Insurance (missing, n=22)					<.001
	None	1955	39.3	35.9	
	Private	2316	46.6	39.6	
	Public	680	13.7	24.1	
Marital status (missing, n=3)					0.18
	Single	2712	54.6	60.0	
	Married/living with a partner	1853	37.3	32.6	
	Separated/divorced/widowed	403	8.1	7.4	
Low socioeconomic status* (missing, n= 1)					<.001
	Yes	2829	56.9	67.8	

	No IUD Expulsion (n=4,971)		IUD Expulsion (n=432)		P value
	N	%	N	%	
BMI (missing, n=56)					0.001
<25	2018	40.6	144	33.3	
25–30	1311	26.4	107	24.8	
>30	1590	32.0	177	41.0	
Nulliparous					<.001
Yes	2047	41.2	135	31.3	
Painful periods (missing, n= 16)					0.07
Yes	1529	30.8	153	35.4	
Heavy periods (missing, n=16)					<.001
Yes	1030	20.7	136	31.5	
IUD type					0.84
Copper IUD	1091	22.0	93	21.5	
Levonorgestrel IUD	3880	78.0	339	78.5	
Immediate postabortion insertion					0.002
Yes	820	16.5	97	22.5	

* Low socioeconomic status defined as receipt of public assistance or reported difficulty paying for transportation, housing, medical expenses or food in past 12 months

BMI - body mass index; IUD - intrauterine device

Totals may not add up to 100% due to rounding or missing data.

Table 2

Rates of Cumulative Expulsion for Cohort Overall and by Selected Baseline Characteristics at 3, 6, 12, 24, and 36 Months (rates per 100 IUD users).

	Number of Months of IUD use										
	3		6		12		24		36		
	N	Rate (95% CI)	N	Rate (95% CI)	N	Rate (95% CI)	N	Rate (95% CI)	N	Rate (95% CI)	P Value*
Overall	5053	2.6 (2.2–3.0)	4750	4.2 (3.7–4.8)	4217	6.2 (5.5–6.9)	2416	8.5 (7.7–9.3)	815	10.2 (9.2–11.3)	n/a
Age											<.001
< 20 years	493	3.5 (2.2–5.5)	451	7.1 (5.2–9.7)	378	10.5 (8.0–13.5)	203	16.4 (13.2–20.3)	60	18.8 (15.1–23.4)	
20 years	4560	2.5 (2.1–2.9)	4301	3.9 (3.4–4.5)	3839	5.7 5.1–6.4	2213	7.7 (6.9–8.5)	755	9.3 (8.3–10.4)	
Baseline BMI											<.001
<30	3366	2.1 (1.7–2.6)	3163	3.8 (3.2–4.5)	2780	5.6 4.8–6.4	1564	7.4 (6.6–8.4)	549	9.1 (8.0–10.4)	
30	1631	3.6 (2.8–4.6)	1537	5.2 (4.3–6.4)	1389	7.5 6.3–8.8	807	10.7 (9.3–12.4)	259	12.3 (10.6–14.3)	
Parity											<.001
0	2065	1.5 (1.1–2.2)	1955	2.9 (2.3–3.7)	1747	4.3 (3.5–5.3)	967	6.5 (5.4–7.7)	321	8.4 (7.0–10.1)	
1 +	2988	3.2 (2.7–3.9)	2795	5.1 (4.4–6.0)	2470	7.4 (6.5–8.4)	1449	9.9 (8.8–11.0)	494	11.4 (10.1–12.8)	
Immediate post-abortion insertion											<.001
Yes	832	4.4 (3.2–6.0)	773	6.8 (5.3–8.6)	671	8.7 (7.0–10.8)	438	11.0 (9.0–13.5)	165	13.4 (10.9–16.3)	
No	4222	2.2 (1.8–2.7)	3977	3.7 (3.2–4.3)	3547	5.6 (5.0–6.4)	1978	8.0 (7.2–8.9)	650	9.5 (8.5–10.7)	
IUD type											0.99
Levonorgestrel IUD	3941	2.7 (2.2–3.2)	3726	4.4 (3.8–5.1)	3312	6.3 (5.6–7.1)	1940	8.5 (7.6–9.4)	670	10.1 (9.0–11.3)	
Copper IUD	1114	2.2 (1.5–3.2)	1024	3.6 (2.7–4.9)	905	5.7 (4.5–7.3)	476	8.6 (7.0–10.6)	145	10.7 (8.6–13.3)	
Heavy menses											<.001
Yes	1070	3.9 (3.0–5.3)	987	6.5 (5.2–8.1)	887	8.8 (7.2–10.6)	500	12.8 (10.9–15.0)	180	14.6 (12.2–17.3)	
No	3967	2.2 (1.8–2.7)	3748	3.6 (3.1–4.2)	3315	5.4 (4.8–6.2)	1908	7.3 (6.5–8.2)	630	9.0 (8.0–10.2)	

* P values calculated using the log-rank test

Note – n for subgroups may not add to total N due to missing data.

BMI – body mass index; IUD – intrauterine device; LNG-IUS – levonorgestrel intrauterine system.

Table 3

Rates of Cumulative Expulsion for Nulliparous Compared to Parous Women Stratified by Age (rates are per 100 IUD users)

		3 Months		6 Months		12 Months		24 Months		36 Months		P Value*
		N	Rate (95%CI)	N	Rate (95%CI)	N	Rate (95%CI)	N	Rate (95%CI)	N	Rate (95%CI)	
Age < 20	Nulliparous	340	3.1 (1.7–5.5)	311	6.6 (4.4–9.8)	268	9.8 (7.1–13.5)	144	15.3 (11.7–20.0)	44	18.7 (14.1–24.4)	0.47
	Parous	154	4.3 (2.1–8.9)	140	8.2 (4.9–13.8)	111	11.9 (7.7–18.3)	59	18.9 (13.2–26.7)	16	18.9 (13.2–26.7)	
Age 20	Nulliparous	1725	1.2 (0.8–1.9)	1645	2.2 (1.6–3.0)	1479	3.2 (2.5–4.2)	823	4.7 (3.8–5.9)	277	6.5 (5.1–8.2)	<.001
	Parous	2835	3.2 (2.6–3.9)	2657	5.0 (4.2–5.8)	2360	7.2 (6.3–8.2)	1390	9.4 (8.3–10.6)	478	11.0 (9.7–12.4)	

* Log-rank test for equality of survivor function for difference in expulsion rates.

Table 4
Rates of Cumulative Expulsion for Nulliparous Compared to Parous Women Stratified by IUD Type (rates are per 100 IUD users)

		3 Months		6 Months		12 Months		24 Months		36 Months		P Value *
		N	Rate (95%CI)	N	Rate (95%CI)	N	Rate (95%CI)	N	Rate (95%CI)	N	Rate (95%CI)	
LNG-IUS	Nulliparous	1604	1.4 (0.9–2.1)	1527	2.7 (2.0–3.6)	1368	3.8 (3.0–4.9)	758	5.4 (4.4–6.7)	264	6.9 (5.5–8.6)	<.001
	Parous	2337	3.5 (2.9–4.3)	2199	5.5 (4.7–6.5)	1944	7.9 (6.9–9.1)	1155	10.5 (9.3–11.9)	406	12.2 (10.7–13.9)	
Copper IUD	Nulliparous	462	2.1 (1.1–3.8)	429	3.6 (2.3–5.8)	379	6.0 (4.1–8.6)	182	10.3 (7.6–13.9)	57	14.3 (10.3–19.6)	0.10
	Parous	652	2.2 (1.3–3.7)	596	3.6 (2.4–5.3)	529	5.5 (4.0–7.6)	294	7.5 (5.6–9.9)	88	8.2 (6.2–11.0)	

* Log-rank test for equality of survivor function for difference in expulsion rates.

Table 5
Adjusted Cox proportional hazards regression of baseline characteristics associated with IUD expulsion stratified by IUD type*

	Levonorgestrel IUD			Copper IUD		
	N	HR	95% CI	N	HR	95% CI
Age 14–19 years	439	2.26	1.68, 3.06	90	3.06	1.75, 5.33
Age 20 years	3780	Ref	Ref	1094	Ref	Ref
White/Other race	2192	Ref	Ref	740	Ref	Ref
Black race	2027	1.32	1.03, 1.68	444	0.92	0.56, 1.49
BMI <30	2776	Ref	Ref	804	Ref	Ref
BMI 30	1401	1.27	1.02, 1.60	366	1.16	0.72, 1.86
Married/living with a partner	1511	0.85	0.67, 1.08	483	0.91	0.58, 1.45
Single/separated/divorced/widowed	2707	Ref	Ref	699	Ref	Ref
Low socioeconomic status	2445	1.48	1.13, 1.92	677	0.83	0.53, 1.31
Nulliparous	1690	0.59	0.44, 0.78	492	1.11	0.67, 1.84
Heavy periods	961	1.64	1.30, 2.06	205	1.73	1.08, 2.78
Immediate postabortion insertion	749	1.33	1.03, 1.71	168	1.01	0.55, 1.83

* Model adjusted for age 14–19, race, obesity, marital status, low socioeconomic status, nulliparity, self-reported heavy periods, and immediate postabortion placement.
IUD – intrauterine device; BMI –body mass index;