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Changes in Body Composition in Women using Long-acting Reversible Contraception

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Abstract

Objective—Users of hormonal long-acting reversible contraception (LARC) report weight gain as a side effect, but few studies have assessed body composition change among LARC users. We evaluated weight and body composition of healthy women using the levonorgestrel intrauterine system (LNG-IUS), copper intrauterine device (copper IUD), or etonogestrel implant (ENG implant). We hypothesized that weight gain and body composition over 12 months would not differ between copper IUD, LNG-IUS, and ENG implant users.

Study Design—We performed a prospective cohort study of a subgroup of women enrolled in the Contraceptive CHOICE Project who initiated the LNG-IUS, copper IUD, or ENG implant. Inclusion criteria included lack of metabolic and eating disorders, or change in body weight of

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Conflicts of interest: Dr. Peipert receives research support from Bayer, Teva, and Merck, and serves on Advisory Boards for Teva and Perrigo. Dr. Madden serves on a scientific advisory board for Bayer Healthcare Pharmaceuticals and on a data safety monitoring board for phase 4 safety studies of Bayer contraceptive products. The other authors declare no conflict of interest. The authors are responsible for the content and the writing of the paper.

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more than 5% in the six months before enrollment. We measured changes in weight and body composition (body fat percentage, total body fat mass, total lean mass, and total body mass) in women who continued their method for 12 months.

Results—We analyzed data from 149 participants: 85 LNG-IUS users, 31 copper IUD users, and 33 ENG implant users. The mean age was 25.9 years, 56.4% were white, 82.5% had some college education, and 67.6% were nulliparous. Although lean body mass increased over 12 months in LNG-IUS and copper IUD users but not in ENG implant users, changes in body weight and body composition did not differ between the groups. In the adjusted model, black race was associated with change in total body mass ($P < 0.05$).

Conclusions—Among those who continued the method for 12 months, changes in body weight and composition did not differ between copper IUD, LNG-IUS, and ENG implant users.

Keywords

Body composition; weight; contraception; levonorgestrel intrauterine system; etonogestrel subdermal implant; copper intrauterine device

1. Introduction

Long-acting reversible contraceptive (LARC) methods are highly effective, safe, and cost-effective. LARC methods include the copper intrauterine device (copper IUD), the levonorgestrel intrauterine system (LNG-IUS), and the subdermal etonogestrel-releasing implant (ENG implant). These methods are 20-fold more effective than oral contraceptive pills, patch, and ring, and provide long-term protection against unintended pregnancy [1,2,3]

Early discontinuation limits the effectiveness of contraceptives. Several studies have indicated that women may discontinue hormonal contraception as a result of a commonly perceived side effect of weight gain [4–6]. Changes in weight are most consistently reported in users of depot medroxyprogesterone acetate (DMPA) [7,8], but changes have also been reported in LARC users. Nault et al. found that more than 30% of LNG-IUS and ENG implant users perceived weight gain, and Dickerson and colleagues noted that 12% of LNG-IUS users and 31% of ENG implant users reported weight gain as a side effect [6,9].

Only a few studies have evaluated changes in body composition in LARC users. Two prospective studies evaluated body composition by dual energy X-ray absorptiometry (DXA) in women between 18 and 46 years of age. These studies showed that body fat percentage increased in LNG-IUS and ENG implant users and decreased in copper IUD users [10,11].

The primary aim of this study was to evaluate changes in body composition (body fat percentage, total body fat mass [g], total lean mass [g], total body mass [kg]) in users of the LNG-IUS and ENG implant over 12 months of continuous use and compare the findings to users of the copper IUD. We chose copper IUD users as the reference group because it is a non-hormonal LARC method, whereas the LNG-IUS and ENG implant are progestin-only methods. Our secondary aim was to assess physical activity and eating behaviors. We

hypothesized that changes in weight gain and body composition or weight over 12 months would not differ between the three groups.

2. Materials and Methods

We conducted a prospective cohort substudy of the Contraceptive CHOICE Project (CHOICE). CHOICE provided no-cost reversible contraceptive methods to more than nine thousand women in the St. Louis region between 14 and 45 years of age and followed them for 2–3 years. Eligibility criteria for CHOICE included English or Spanish speaking, sexually active or planning to become sexually active with a male partner, and willingness to start a new contraceptive method [12]. After receiving tier-based counseling based on method effectiveness, participants could choose any FDA-approved reversible contraceptive method [13].

Between December 2010 and July 2013, CHOICE participants between 18 and 45 years of age who enrolled at our university and chose the LNG-IUS (Mirena®, Bayer Pharmaceuticals, Wayne, NJ), the copper IUD (ParaGard®, Barr Pharmaceuticals, Montvale, NJ), or the ENG contraceptive implant (Implanon®, Schering Corporation, Kenilworth, NJ) were approached for interest in participation in this sub-study. Participants had to be willing to undergo a dual-energy X-ray absorptiometry (DXA) bone densitometry scan (GE Lunar iDXA system, version:13.31, WI, USA) and return for in-person follow-up visits at 6 and 12 months. Exclusion criteria for this study included the following: 1) known metabolic or eating disorders that can affect body weight; 2) 5% or greater change in body weight in the six months before enrollment; 3) current use of antidepressants, antipsychotics, or oral glucocorticoids; and 4) currently breastfeeding. We excluded data of women from the analysis if they discontinued their contraceptive method before the 12-month time point. We obtained approval from the Washington University School of Medicine Human Research Protection Office for this substudy (#201105463); all women signed an informed consent form.

After screening, participants completed three in-person visits in our university: at baseline, at 6-months, and at 12 months. At enrollment and the 12-month visit, we evaluated weight, height, eating behavior and physical activity and performed a DXA scan. At the 6-month visit, we evaluated weight, height, eating behavior, and physical activity. We compensated the participants with a $50 gift card at enrollment and at 12 months, and a $25 gift card at 6 months.

Because of the possibility that low-dose progestin is associated with changes in weight and body composition, we considered women who received the copper IUD, which is non-hormonal, as the referent group. We analyzed the change of weight and body composition over 12 months of continuous use of the same contraceptive method. Additionally, we assessed baseline demographic characteristics of discontinuers and compared these characteristics to continuers. Our primary outcomes were the mean changes in total body mass (kg), body fat percentage, total body fat mass (g), and total lean mass (g) over time of LNG-IUS, ENG implant, and copper IUD users. We also evaluated weight, body mass index (BMI), physical activity, and eating behavior as our secondary outcomes.

2.1 Definition of variables

Independent (exposure) variables were the contraceptive methods: LNG-IUS, copper IUD, or ENG implant. The dependent variables (outcomes of interest) were weight and body composition. We measured weight and height on the same scale at the beginning of the study and after 12 months of continuous contraceptive use. Trained technicians used DXA to quantitate total body tissue and evaluate whole-body composition [14,15] (body fat percentage, total body fat mass [g], total lean mass [g], and total body mass [kg]) at baseline and after 12 months. The coefficients of variation for the total body percentage fat, lean mass, and fat mass measurements were 0.8%, 0.5%, and 0.8%, respectively. We calculated the body mass index as [weight (kg)/(height (m)^2]. We used the Seven-Day Physical Activity Recall questionnaire [16] to obtain frequency, intensity, time, and type of physical activities at the beginning of the study and after 12 months. Self-reported recall focused on occupational, household, and sports or recreation activities. The average energy expenditure for each activity for the seven days preceding the interviews was converted to metabolic equivalent tasks (METs) as described by Sallis [16].

We used the self-administered Three-Factor Eating Questionnaire (TFEQ) to assess eating behaviors. The TFEQ contains 51 questions and measures three domains of human eating behavior: ‘cognitive restraint of eating’ (Factor I - 21 questions), ‘disinhibition’ (Factor II–16 questions), and ‘hunger’ (Factor III–14 questions). Each question is attributed a score of 0 or 1 points. The possible scores for Factors I, II, and III are 0–21, 0–16, and 0–14, respectively [17]. The TFEQ is often used in eating behavior research and is validated for use in women [18].

2.2 Statistical analysis

We compared demographic, socioeconomic, and reproductive characteristics between the groups at baseline by using Chi-square or Fisher`s exact test for categorical variables. We compared the means (± standard deviation [s.d.]) of weight, BMI, physical activity, eating behavior, and body composition at baseline and 12 months by one-way univariate ANOVA. For variables with $P<.05$, we performed the Bonferroni (Dunn) t-test post-hoc test. Additionally, we used paired t-tests for each contraceptive method to investigate the mean variations (baseline mean measurements subtracted from the 12-month mean measurements) of weight, BMI, physical activity, eating behavior, and body composition of the participants who had both baseline and 12 months data. We performed univariate and multivariable linear regression to identify characteristics associated with the mean change in total body mass (kg) after 12 months. We used a simple linear regression model to compare total body mass change between LNG-IUS and copper IUD users and between ENG implant and copper IUD users. We defined significance level as $P < 0.05$ and used SAS (Statistical Analysis System, version 9.4; SAS Institute Inc. Cary, NC, USA) for all statistical analyses.

For our sample size calculation, we assumed a mean change of +0.6 kg in copper IUD users over 12 months; this was the mean weight change in U.S women over this period reported by the National Health and Nutrition Examination Survey [19]. Among users of the LNG-IUS and the ENG implant, we assumed a mean weight gain of 2.0 kg. To perform analysis of

variances, and considering a significance level of 5% and power of 80%, we estimated a requirement of 73 women in each group.

3. Results

We enrolled 232 women into this substudy. Of these, 149 women used their baseline contraceptive method continuously for 12 months and were included in our analysis: 85 LNG-IUS users, 33 ENG implant users, and 31 copper IUD users (see Figure 1).

Table 1 shows age, weight, BMI, physical activity, eating behavior, body composition, and demographic characteristics at baseline stratified by contraceptive method of the participants whose data we analyzed in our substudy. Of the total sample, the mean (± s.d.) age was 25.9 (5.7) years, more than 50.0% of users self-identified as white, 80.0% had some college or graduate school, and 60.0% were nulliparous. We found no significant differences in demographic characteristics of the participants who continued their methods and completed the 12-month follow-up and those who did not. In the group who discontinued the contraceptive method, the mean age was 25.9 (5.7) years, 52.0% of users self-identified as white, 65.7% had some college or high school, and 61.2% were nulliparous. We found no statistically significant difference in the weights or body fat percentage when we compared participants who continued use for 12 months to those that discontinued use. Additionally, there was no significant difference in the BMI at 6 months between the continued and discontinued groups.

Table 2 contains the body weight, BMI, physical activity, eating behavior, and body composition measures for continuous users at baseline and 12 months. Changes in weight, BMI, eating behavior, and body composition over 12 months of continuous use did not differ between the three groups. The ENG implant users reported higher metabolic expenditure (physical activity) than did the copper IUD users at 12 months (per day: difference in means of ENG implant and copper IUD=1.67, 95%CI: 0.006–3.20, $P<.05$; per week: difference in means of ENG implant and copper IUD=11.24, 95%CI: 0.042–22.45, $P<.05$). Additionally, we found a mean increase of 0.5, 0.4, and 0.1 kg of body weight in users of LNG-IUS, copper IUD, and ENG implant, respectively, after 12 months of continuous use. BMI and physical activity did not change over 12 months in any of the groups. Cognitive restraint of eating, cognitive disinhibition, and subjective appetite decreased in LNG-IUS ($P<.001$), copper IUD ($P<.005$) and ENG implant ($P<.05$) users. Lean body mass increased between baseline and 12 months in LNG-IUS users (+ 464.7 g; $P=.03$) and copper IUD users (+ 788.7 g; $P=.03$).

We provide univariate and multivariable linear regression models with the mean of total body mass (kg) change at 12 months in Table 3. Contraceptive method was not associated with change in body mass at 12 months in either the unadjusted or adjusted models. In both models, black race was associated with change in total body mass over time.

4. Discussion

In this prospective substudy, we found that changes in weight, BMI, and body composition among those with 12 months of continuous use did not differ between users of the LNG-

IUS, the ENG implant, and the copper IUD. Additionally, in both the unadjusted and adjusted linear regression models, black race was associated with change in total body mass at 12 months.

The LNG-IUS and ENG implant are progestin-only contraceptive methods. The LNG-IUS is a 20mcg/day levonorgestrel-releasing intrauterine system, and the ENG implant is a single-rod of 68mg etonogestrel-releasing subdermal implant. The systemic serum concentration of progestin in the LNG-IUS is lower than the ENG implant. Pain and irregular bleeding are the major reasons for their early discontinuation [6,20]. Weight gain has been a reported reason for method discontinuation by 5% to 20% of ENG implant users [6,20] and 15% to 20% of LNG-IUS users [6]. In our study, we observed a mean increase of 0.5 and 0.1 kg in users of the LNG-IUS and ENG implant, respectively, after 12 months of continuous use. In the Cochrane systematic review, Lopez and colleagues reported mean weight gain of less than 2 kg in users of progestin-only contraceptive methods [21]. In contrast, two prospective studies showed a weight gain of 2.9 kg in LNG-IUS users [10] and 4.1 kg in ENG implant users [11] after 12 months of continuous use.

Regarding body composition, two other prospective studies reported differences in body composition changes over 12 months. In a study of 75 ENG implant users and 75 copper IUD users, Modesto and colleagues found that women using the ENG implant had a 2% increase in body fat and a 2.4 kg increase in fat mass, whereas copper IUD users had no significant increase in body fat or fat mass [11]. Dal'Ava et al. studied 76 LNG-IUS users and 76 copper IUD users, matched by age and baseline body mass index, and observed a 2.5% increase in body fat in LNG-IUS users but no significant increase in body fat in copper IUD users [10]. In our comparison within each contraceptive method group, we noted that lean body mass increased in LNG-IUS and copper IUD users. However, our small sample size in the copper IUD and ENG implant groups provided limited power to detect a difference. We observed an association between black race and increased body mass over time. Other prospective studies of adult and adolescent users of DMPA or LARC contraceptives methods (LNG-IUS, ENG implant, and copper IUD) also found an association between black race and weight gain [7,22].

After 12 months of use, ENG implant users reported a greater increase of metabolic expenditure (physical activity) than LNG-IUS and copper IUD users. We found one other prospective study that evaluated body composition and lifestyle habits (smoking, alcohol, and physical activity) and compared 20 DMPA users and 20 copper IUD users, matched by age and body mass index. This report dichotomized physical activity as "yes" (aerobic activity ≥ 150 min/week) or "no" (aerobic activity < 150 min/week or none at all). The investigators reported no statistical differences between lifestyle habits and these contraceptives groups at baseline and 12 months [23]. It is possible that our findings of increased self-reported physical activity are due to social desirability bias [24].

We noted that self-reported eating behavior scores decreased in each contraceptive group after 12 months of use. When we searched the medical literature by using MEDLINE, EMBASE, POPLINE, and Scopus (search terms: "body weight changes AND contraceptive agents, female"; "body weight AND contraceptive methods"; "eating behavior AND

contraception”), we found no published studies evaluating eating behavior using the TFEQ in LARC users. The TFEQ is a validated questionnaire used in clinical research to assess eating behaviors over time in women [18]. Higher scores indicate higher probability of restrained eating, disinhibited eating, and predisposition to hunger. Scores of cognitive disinhibition are directly associated with weight change and total body mass; therefore, higher scores on Factor II reveal higher predisposition to weight gain [17]. Studies of adult contraceptive users of DMPA and oral contraceptive pills have assessed appetite by using “no/yes” questions [8,25]. However, these studies did not evaluate whether changes in eating behaviors over time differed between contraceptive groups. Bonny and colleagues, using the same TFEQ methodology, reported higher appetite score in black adolescent DMPA users than in white DMPA users at six months of use; restrained and disinhibited eating were predictors of weight gain in black adolescents. Additionally, these investigators showed an increase of weight and body fat percentage in black subjects [7]. We have no clear explanation for the reported decrease in eating behavior over time in our cohort other than the possibility of social desirability bias [26,27].

A woman may believe that her contraceptive method is responsible for weight gain [6,9] and thus choose to discontinue the method [20]. In our study, we excluded from analysis women who discontinued their contraceptive method before 12 months. We did not collect reasons for discontinuation and thus do not know whether they discontinued because of real or perceived weight gain. However, this group had similar baseline characteristics as those who continued the same contraceptive method over 12 months.

In our substudy, we enrolled healthy adult women from a single geographic region who had no eating disorder history or important weight change in the recent past. The principal strengths of our study are prospective design in a contemporary cohort of LARC users, use of validated measures of eating behavior and body composition, and a multivariable analysis to attempt to control for confounding. However, key limitations include loss of more than one-third of participants because of method discontinuation, small sample size of ENG implant and copper IUD users, and lack of randomization. The generalizability of our findings are limited as our study only included participants who used their method continuously for 12 months. Additionally, we informed the participants that the study was evaluating change in body composition over time; this may have led to increased attention to physical activity and eating behavior, or at least reporting desirable behaviors.

5. Conclusion

In a subgroup of CHOICE participants who continued their LARC method for 12 months, we found that changes in weight and body composition over time did not differ between users of LNG-IUS, ENG implant, or copper IUD. Additionally, there was no significant difference in the BMI at 6 months between the continued and discontinued groups. We noted that black race was associated with an increase in body mass. Our results add to the body of literature regarding weight and body composition changes with contraceptive use. Additional prospective studies with a sufficient number of subjects in each contraceptive group are necessary to confirm or refute our findings.

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Implications statement

Changes in body weight and composition over 12 months did not differ between copper IUD users and LNG-IUS and ENG implant users among those with 12 months of continuous use.

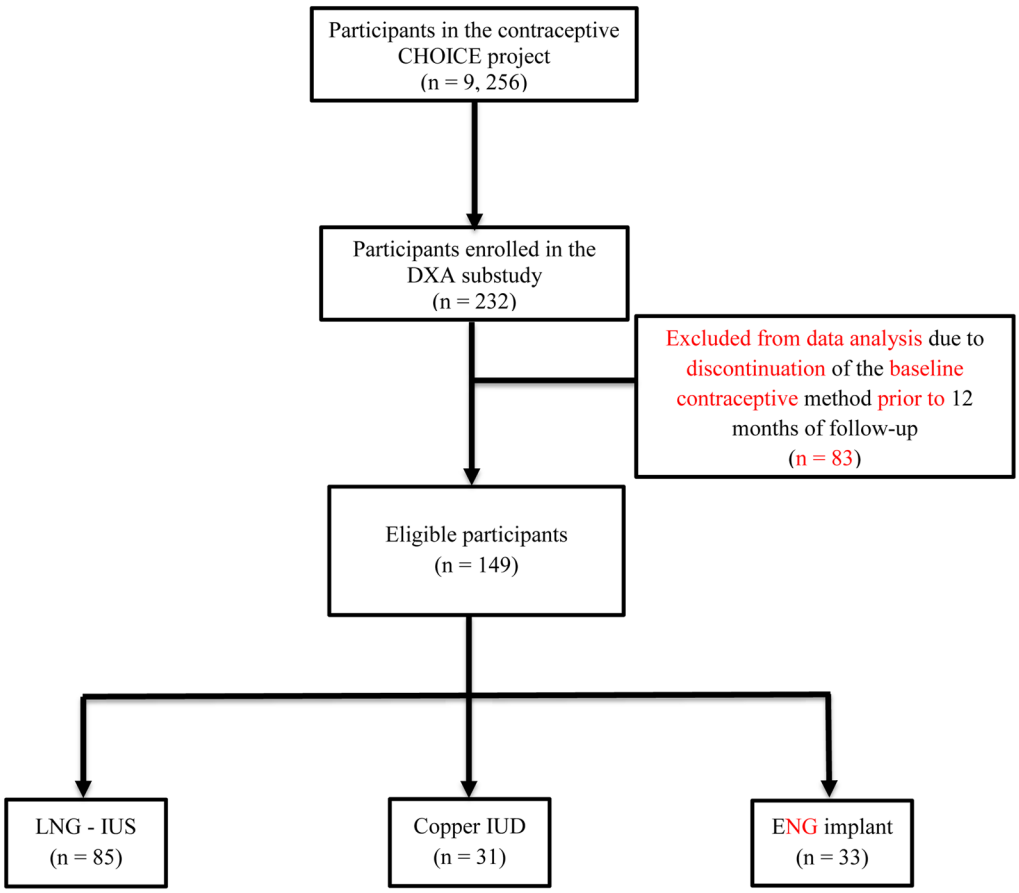

Figure 1.
Analytic sample selection flow chart

Table 1

Baseline characteristics of the participants included according to contraceptive method.

Characteristics	Total n=149	LNG-IUS n=85	Copper IUD n=31	ENG implant n=33	
	mean±SD[missing data]				
					P-value *
Age, years	25.9±5.7	25.6±5.4	26.8±5.9	26.1±6.5	0.59
Weight, kg	75.6±21.3[3]	75.1±21.3[1]	78.4±27.1[1]	74.3±14.6[1]	0.71
BMI, kg/m^2	28.1±7.6[11]	27.8±7.6[7]	28.7±8.8[1]	28.0±6.3[33]	0.89
Physical Activity (METs)					
Total kcal/kg per day	34.9±3.7	34.8±3.6	34.4±2.4	35.5±4.8	0.52
Total kcal/kg per week	244.2±26.0	243.9±25.5	240.9±17.1	248.2±33.3	0.52
Eating Beahvior					
Restrained eating	8.4±4.0	8.4±3.8	8.0±4.1	8.8±4.3	0.71
Disinhibited eating	5.7±2.8	5.7±2.8	5.6±3.2	5.9±2.3	0.91
Appetite	5.4±2.6	5.4±2.5	5.5±2.6	5.3±2.7	0.98
DXA measurements					
Total body mass, kg	74.8±21.0	74.3±20.8[1]	77.6±27.2[1]	73.5±14.3[1]	0.70
body fat (%)	39.5±8.3	38.7±8.5[1]	40.8±9.0[1]	40.4±7.4[1]	0.41
Body lean mass, g	42309.7±7252.6	42482.2±7014.9[1]	42637.0±9632.7[1]	41549.5±5166.6[1]	0.79
Body fat mass, g	29849.0±14820.1	29209.7±14544.0[1]	32556.3±18292.7[1]	28989.0±11788.9[1]	0.53
	n (%)	n (%)	n (%)	n (%)	
Race					0.57
White	84(56.4)	43 (50.6)	21 (67.7)	20 (60.6)	
Black	58 (38.9)	37 (43.5)	9 (29.0)	12 (36.4)	
Other	7 (4.7)	5 (5.9)	1 (3.2)	1 (3.0)	
Education					0.63
≤ High school	26 (17.4)	16 (18.8)	4 (12.9)	6 (18.2)	
Some College	68 (45.6)	37 (43.5)	13 (41.9)	18 (54.5)	
College/Graduate school	55 (36.9)	32 (37.6)	14 (45.2)	9 (27.3)	

Characteristics	Total n=149	LNG-IUS n=85	Copper IUD n=31	ENG implant n=33	
	mean±SD[missing data]				
Marital status					0.61
Single/never married	93 (65.5)	57 (69.5)	17 (60.7)	19 (59.4)	
Married/living with partner	39 (27.5)	19 (23.2)	10 (35.7)	10 (31.3)	
Separated/divorced/widowed	10 (7.0)	6 (7.3)	1 (3.6)	3 (9.4)	
Receiving public assistance					0.35
Yes	43 (29.5)	22 (26.2)	12 (40.0)	9 (28.1)	
No	103 (70.5)	62 (73.8)	18 (60.0)	23 (71.9)	
Monthly income					0.36
None	23 (16.2)	18 (22.0)	2 (7.1)	3 (9.4)	
$1 – $800	41 (28.9)	25 (30.5)	7 (25.0)	9 (28.1)	
$801 – $1,600	45 (31.7)	21 (25.6)	12 (42.9)	12 (37.5)	
>$1,600	33 (23.2)	18 (22.0)	7 (25.0)	8 (25.0)	
Health insurance					0.51
None	54 (38.0)	32 (39.0)	10 (35.7)	12 (37.5)	
Commercial	80 (56.3)	43 (52.4)	17 (60.7)	20 (62.5)	
Public	8 (5.6)	7 (8.5)	1 (3.6)	0 (0.0)	
Parity					0.18
0	69 (67.6)	58 (70.7)	20 (71.4)	18 (56.3)	
1	16 (11.3)	6 (7.3)	5 (17.9)	5 (15.6)	
≥2	30 (21.1)	18 (22.0)	3 (10.7)	9 (28.1)	

BMI: body mass index; METs: metabolic equivalent intensity levels; DXA: dual-energy X-ray absorptiometry; LNG-IUS: levonorgestrel-releasing intrauterine system; ENG implant: etonogestrel implant; Copper IUD: copper intrauterine device;

*One-way univariate test (for continuous variables), Chi-square test for categorical variables, and Fisher's Exact test for categorical variables with cases less than 5 in some cells.

Table 2

Variation in weight, BMI, physical activity, eating behavior and body composition over 12 months of continuous use according to LARC methods.

Characteristics	Total Sample	LNG-IUS	Copper IUD	ENG implant	P- value*
	mean±SD (n)	mean±SD (n)	mean±SD (n)	mean±SD (n)	
Weight, kg					
Baseline	74.5±22.5 (100)	73.3±22.3 (57)	77.4±30.6 (20)	75.1±14.1 (23)	0.78
12 months	74.9±22.9 (100)	73.8±23.3(57)	77.8±30.7 (20)	75.2±13.1 (23)	0.79
Δ in weight, mean (95%CI)	0.4 (−0.6, 1.4)	0.5 (−0.8, 1.8)	0.4 (−2.5, 3.4)	0.1 (−2.0, 2.4)	0.97
P-value*	0.44	0.47	0.74	0.88	
BMI, kg/m²					
Baseline	27.6±7.9 (95)	27.1±7.9 (54)	28.3±8.8 (20)	28.1±6.2 (21)	0.80
12 months	27.7±8.0 (95)	27.2±8.1(54)	28.5±9.9 (20)	28.3±6.0 (21)	0.79
Δ in BMI, mean (95%CI)	0.1 (−0.3, 0.5)	0.1 (−0.4, 0.6)	0.2 (−1, 1.3)	0.2 (−0.7, 1)	0.99
P-value*	0.52	0.67	0.77	0.69	
Physical Activity					
METs / day					
Baseline	34.9±3.7(149)	34.8±3.6(85)	34.4±2.4(31)	35.5±4.8(33)	0.52
12 months	35.1±2.7(149)	34.9±2.4(85)	34.4±1.7(31)	36.0±3.8(33)	0.04
Δ in METs / day, mean (95%CI)	0.2 (−0.5, 0.9)	0.1 (−0.8, 1)	0.0 (−1, 1)	0.6 (−1.5, 2.6)	0.84
P-value*	0.60	0.83	0.98	0.57	
METs / week					
Baseline	244.2±26.0 (149)	243.9±25.5 (85)	240.9±17.1 (31)	248.2±33.3 (33)	0.52
12 months	245.5±18.8 (149)	244.6±16.5 (85)	241.0±11.6 (31)	252.2±26.8 (33)	0.04
Δ in METs / week, mean (95%CI)	1.3 (−3.6, 6.1)	0.7 (−5.6, 6.9)	0.1 (−6.7, 6.9)	4 (−10.2, 18.2)	0.84
P-value*	0.60	0.83	0.98	0.57	
Eating Behavior					
Restrained eating					
Baseline	8.4±4.0 (149)	8.4±3.8 (85)	8.0±4.1(31)	8.8±4.3 (33)	0.71
12 months	5.7±5.1 (149)	6.1±5.4 (85)	4.8±4.5 (31)	5.8±4.8 (33)	0.48
Δ in restrained eating, mean (95%CI)	−2.6 (−3.5, − 1.8)	−2.3 (−3.3, − 1.2)	−3.2 (−5.1, − 1.2)	−3 (−5.1, −1)	0.63

Characteristics	Total Sample	LNG-IUS	Copper IUD	ENG implant	P- value*
	mean±SD (n)	mean±SD (n)	mean±SD (n)	mean±SD (n)	
P-value*	<0.001	<.001	0.003	0.005	
Disinhibited eating					
Baseline	5.7±2.8 (149)	5.7±2.8 (85)	5.6±3.2 (31)	5.9±2.3 (33)	0.91
12 months	3.8±3.4 (149)	3.9±3.7 (85)	3.1±2.7 (31)	3.9±3.2 (33)	0.45
Δ in disinhibited eating, mean (95%CI)	−2.0 (−2.6, − 1.4)	−1.8 (−2.5, −1)	−2.6 (−4.1, −1)	−2 (−3.2, −0.8)	0.57
P-value*	<0.001	<.001	0.002	0.002	
Appetite					
Baseline	5.4±2.6 (149)	5.4±2.5 (85)	5.5±2.6 (31)	5.3±2.7 (33)	0.98
12 months	3.4±3.0 (149)	3.5±3.0 (85)	2.9±2.8 (31)	3.8±3.1 (33)	0.49
Δ in Appetite, mean (95%CI)	−2.0 (−2.5, − 1.3)	−1.9 (−2.7, − 1.1)	−2.5 (−3.9, − 1.2)	−1.6 (−2.8, − 0.3)	0.54
P-value*	<0.001	<.001	<.001	0.01	
DXA measurements					
Total body mass, kg					
Baseline	73.7±22.2 (100)	72.5±21.7 (57)	76.6±30.8 (20)	74.2±13.8 (23)	0.77
12 months	74.1±22.7 (100)	72.9±22.9 (57)	77.3±30.7 (20)	74.3±13.1 (23)	0.76
Δ in total body mass, mean (95%CI)	0.4 (−0.6, 1.4)	0.4 (−0.9, 1.8)	0.6 (−2.3, 3.5)	0.1 (−2.0, 2.3)	0.95
P-value*	0.44	0.51	0.66	0.90	
body fat (%)					
Baseline	38.6±8.3 (100)	37.4±8.8 (57)	39.4±9.3 (20)	41.0±7.4 (23)	0.21
12 months	38.1±8.9 (100)	36.9±9.0 (57)	39.0±9.1 (20)	40.6±8.1 (23)	0.21
Δ in body fat, mean (95%CI)	−0.5 (−1.1, 0.2)	−0.5 (−1.3, 0.3)	−0.4 (−2.7, 1.8)	−0.4 (−1.8, 0.9)	0.99
P-value*	0.17	0.21	0.68	0.52	
Body lean mass, g					
Baseline	42156.2±707 2.6 (100)	42203.2±109 60.9 (57)	42758.2±963 2.7 (20)	41516.2±4837 .0 (23)	0.86
12 months	42653.3±726 7.5 (100)	42667.9±110 41.9 (57)	43546.9±110 41.9 (20)	41840.2±4140 .7 (23)	0.77
Δ in body lean mass, mean (95%CI)	497.1 (178.7, 815.6)	464.7(45.8, 883.5)	788.8(99.6, 1477.9)	324 (−456.9, 1104.9)	0.62
P-value	0.003	0.03	0.03	0.40	

Characteristics	Total Sample	LNG-IUS	Copper IUD	ENG implant	P- value*
	mean±SD (n)	mean±SD (n)	mean±SD (n)	mean±SD (n)	
Body fat mass, g					
Baseline	29015.7±152 82.1 (100)	27694.9±150 50.4 (57)	31406.2±202 34.4 (20)	30210.6±1046 6.6 (23)	0.59
12 months	28183.1±151 86.3 (100)	26369.9±148 62.8 (57)	31209.2±198 94.2 (20)	30045.3±1064 1.2 (23)	0.38
Δ in body fat mass, mean (95%CI)	−832.6 (−2373.1,707.8)	−1325 (−3840.2, 1190.3)	−197 (−2756.6, 2362.7)	−165.3 (−1850.2, 1519.6)	0.77
P-value *	0.29	0.30	0.87	0.84	

Δ (baseline mean measurements subtracted from the 12-month mean measurements); BMI: body mass index; METs: metabolic equivalent intensity levels; LNG-IUS: levonorgestrel-releasing intrauterine system; ENG implant: etonogestrel implant; Copper-IUD: copper intrauterine device; DXA: dual-energy X-ray absorptiometry; CI: confidence interval;

*one-way univariate analysis of variance (ANOVA) for all analyses.

Table 3

Univariate and multivariable linear regression models of characteristics associated with DXA total body mass (kg) change at 12 months.

Characteristics	Mean total body mass Change (beta)	95% CI
Unadjusted Models		
Age	−0.2	−0.38,−0.01
BMI at baseline	−0.01	−0.15,0.13
Race		
White/Others	Ref	
Black	2.68	0.54,4.83
Contraceptive method		
Copper IUD	Ref	
LNG-IUS	−0.17	−2.87,2.52
ENG implant	−0.47	−3.64,2.70
Parity		
0	Ref	
1	2.55	−0.83,5.95
2 or more	−2.37	−5.02,0.28
Education		
High school or less	Ref	
Some college	−0.004	−3.18,3.17
College graduate or more	0.05	−3.15,3.27
Physical activity at baseline		
METs/day	−0.07	−0.33,0.20
Eating Behavior at baseline		
Restrained eating	−0.22	−0.48,0.05
Disinhibited eating	−0.36	−0.73,0.01
Appetite	−0.52	−0.93,−0.10
Adjusted Model		
Age	−0.18	−0.36,−0.00
Race		
White/Others	Ref	
Black	2.59	0.47,4.69
Contraceptive method		
Copper IUD	Ref	
LNG-IUS	−0.31	−2.88,2.26
ENG implant	−0.5	−3.53,2.52
Eating Behavior at baseline		
Appetite	−0.35	−0.83,0.14

CI: confidence interval; METs: metabolic equivalent intensity levels; LNG-IUS: levonorgestrel-releasing intrauterine system; LNG-IUS: levonorgestrel-releasing intrauterine system; ENG implant: etonogestrel implant; Copper IUD: copper intrauterine device