Changes in weight, total fat, percent body fat, and central-to-peripheral fat ratio associated with injectable and oral contraceptive use

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OBJECTIVE: The purpose of this study was to determine changes in bodyweight and composition that result from hormonal contraception.

STUDY DESIGN: Dual-energy x-ray absorptiometry was performed at baseline and every 6 months for 3 years for 703 women (African American, 200; white, 247; Hispanic, 256) who were beginning the use of oral contraception (OC; n = 245), depot medroxyprogesterone acetate (DMPA; n = 240), or nonhormonal contraception (NH; n = 218). DMPA discontinuers were observed for up to 2 years to examine the reversibility of the observed changes.

RESULTS: Over 36 months, DMPA users increased their weight (+5.1 kg), body fat (+4.1 kg), percent body fat (+3.4%), and central-to-peripheral fat ratio (+0.1) more than OC and NH users ($P < .01$). OC use did not cause weight gain. After DMPA discontinuation, NH users lost 0.42 kg in 6 months; OC users gained 0.43 kg in 6 months.

CONCLUSION: Bodyweight and fat significantly increase with the use of DMPA. After discontinuation of DMPA, some decrease in bodyweight and fat occurs when NH is used.

Key words: body fat, body weight, depot medroxyprogesterone acetate, oral contraception

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Weight gain is cited frequently by women as a reason for discontinuing the injectable contraceptive, depot medroxyprogesterone acetate (DMPA).[1-3] However, studies have differed in their findings as to whether this birth control method actually causes an increase in weight. For example, several studies have demonstrated weight gain with the use of DMPA[4-6]; others have shown no effect.[1,7,8] Many of these studies, however, were retrospective in design[4,8-11] or did not include a comparison group of women who used nonhormonal contraception (NH).[8,9,12] In contrast, studies on low-dose oral contraceptives have not shown an effect on weight or body composition.[13,14] However, many of these studies are limited by small sample sizes[14] or merged different formulations of oral contraceptives.[15,16]

Furthermore, most studies on these contraceptive methods have failed to include a diverse sample or did not conduct analyses by race so that racial effects on contraceptive-related weight changes cannot be determined. In addition, almost no studies have followed women after DMPA discontinuation to determine whether any observed weight increases were reversible.

Absence of these data prevents clinicians from being able to advise women on whether weight gain that occurs as a result of the use of hormonal contraception persists after discontinuation.

The purpose of this study was to determine changes in bodyweight and composition during 3 years of hormonal contraceptive use and up to 2 years after discontinuation and to determine the influence of age, race, caloric intake, exercise, and other factors on this relationship. Exploration of these questions will allow clinicians to counsel women about body composition changes that are associated with these popular forms of contraception.

Methods

As part of a larger study to examine the effects of hormonal contraception on bone mineral density,[17] 805 non-Hispanic black, non-Hispanic white, and Hispanic women between 16 and 33 years of age were recruited between October 9, 2001, and September 14, 2004. Recruitment was conducted to achieve a sample that was balanced by age group (16-24 and 25-33 years) and contraceptive method, as previously described.[17] All women underwent eligibility screening that included a medical interview, anthropometry, and fasting phlebotomy during the follicular phase of their menstrual cycle. Criteria for exclusion in-

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cluded current pregnancy or breastfeeding, pregnancy that was planned within the next 3 years, the use of DMPA within the past 6 months, the use of oral contraception within the past 3 months, the current use of hormonal intrauterine device, a contraindication to hormonal contraception, a lack of menses for > 3 months within the past year, bilateral oophorectomy, the use of over-the-counter phytoestrogen supplements, dietary isoflavone intake that exceeded 84 mg/d as determined by a checklist of high-isoflavone foods that was developed from the literature and the United States Drug Administration nutrient database, illnesses or medications that are known to affect bone mineral density (BMD) (anticonvulsants, benzodiazepines, corticosteroids, diuretics, thyroid hormones), eating disorders, and/or strict vegetarian diet. Creatinine, calcium, phosphorus, alanine aminotransferase (ALT), aspartate amino-transferase (AST), thyroid stimulating hormone (TSH), parathyroid hormone (PTH), and 25-OH vitamin D levels were measured, and women were excluded if the results were not within normal reference ranges. Of the 2999 women who responded to advertisements, 1404 women met general inclusion criteria and matched an "open" recruitment cell (age group × race × contraceptive method). Of these, 805 women provided written consent (and parental consent, if < 18 years of age) to undergo further screening for the larger study. Of these, 5 women withdrew before completing their first visit, and 97 had abnormal laboratory or bone scan results (Figure 1). Thus, 703 women were invited to participate in the longitudinal study. Those women who were excluded (n = 102) did not differ from the women who were included in the longitudinal study (n = 703) on age, marital status, parity, or education (all $P > .05$).

After being counseled, the women were allowed to select 1 of 3 types of birth control: 245 women chose oral contraception (OC; 0.15 mg desogestrel + 20 μg ethinyl estradiol taken for 21 days, followed by 2 days of placebo and 5 days of 10 μg ethinyl estradiol); 240 women chose DMPA; and 218 women chose NH methods, which included bilateral tubal ligation, condoms, and abstinence. Contraception was dispensed every 3 months. At baseline and every 6 months thereafter; women were weighed wearing light indoor clothing on a digital scale that was accurate to the nearest 0.1 kg, and height was measured with a wall-mounted stadiometer (Heightronic, Snoqualmie, WA) that was accurate to the nearest 0.001 m.

Total body fat, percent body fat, total lean mass, and body fat distribution measures were obtained by dual-energy x-ray absorptiometry (QDR 4500W densitometer; Hologic Inc, Bedford, MA). Body composition measurements with dual-energy x-ray absorptiometry show a high correlation with other techniques, such as underwater weighing, and has been described as the gold standard. Reliability of the QDR 4500W densitometer as measured by intraclass correlation coefficients are very high (0.997-0.999 for percent body fat and total fat).[18] The central-to-peripheral fat ratio was calculated by dividing the trunk fat by the total of upper and lower limb fat.[5,19] All scans were conducted on a single machine, with no change in software throughout the study. Details of the scan protocol have been previously described.[17] To obtain estimates of daily calorie intake along with amount of protein, fat, and carbohydrate consumed, a registered dietician conducted a 24-hour dietary recall interview with each participant annually. Nutrient calculations were performed with the Nutrition Data System for Research software (version 4.05; Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN).[20]

At baseline and every 6 months thereafter for 36 months, a subset of participants (n = 608) also completed a symptom checklist that included questions on changes in appetite over time (increase or decrease). Women responded "yes" to indicate they had experienced the symptom in the past 3 months or "no" if not. Ninety-five women were enrolled before the addition of this checklist to the study protocol These 95 women did not differ from the 608 women in age, parity, race, marital status, and education. All participants received free well-woman care and contraception and monetary compensation during the study. Those women who did not return for scheduled visits were reminded by phone and certified letters.

Participants also completed a written questionnaire that contained demographic and behavioral measures. Behavioral measures included previous breastfeeding and hormonal contraceptive use, smoking, alcohol use, and physical activity. Tobacco use was measured with questions from the MONICA Smoking Assessment.[21] For analytic purposes, current smokers were those who reported regular or occasional smoking, although nonsmokers were those women who currently did not smoke. Alcohol use was calculated from questions on the Diet History Questionnaire regarding how often subjects drank alcohol (either beer, wine or wine coolers, liquor, or mixed drinks) during the past 12 months and the amount that usually is consumed when drinking.[22] Weight-bearing physical activity was taken from a measure that included a list of 56 common activities and questions on the frequency and duration of ≤ 2 physical activities that had been performed during the past month. We categorized weight-bearing exercise into 2 groups: < 120 and > 121 min/wk.

Of the 240 initial DMPA users, 182 women discontinued this method, 68 of whom remained in the study for ≤ 2 additional years. There were no differences in baseline characteristics between DMPA users who remained in the study (n = 68) and those women who did not (n = 114) with regard to age, race/ethnicity, height, weight, lean mass, age at menarche, lifestyle variables, calcium intake, pregnancy/breast feeding, and previous exposure to OC or DMPA. However, the former were more likely to have a higher body mass index (BMI), exercise more, and have higher baseline fat mass and percent body fat. Of the 68 women who were observed after DMPA discontinuation, 44 women began OC and were given the same formulation that was used in the study; the remaining 24 women chose NH. All procedures were approved by the Institutional Re-