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Do African American Women Require Fewer Calories to Maintain Weight? Results From a Controlled Feeding Trial

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Abstract

Background—The high prevalence of obesity in African American (AA) women may result, in part, from a lower resting metabolic rate (RMR) than non-AA women. If true, AA women should require fewer calories than non-AA women to maintain weight. Our objective was to determine in the setting of a controlled feeding study, if AA women required fewer calories than non-AA women to maintain weight.

Materials and Methods—This analysis includes 206 women (73% AA), aged 22–75 years, who participated in the Dietary Approaches to Stop Hypertension (DASH) trial—a multicenter, randomized, controlled, feeding study comparing the effects of 3 dietary patterns on blood pressure in individuals with prehypertension or stage 1 hypertension. After a 3-week run-in, participants were randomized to 1 of 3 dietary patterns for 8 weeks. Calorie intake was adjusted during feeding to maintain stable weight. The primary outcome of this analysis was average daily calorie (kcal) intake during feeding.

Results—AA women had higher baseline weight and body mass index than non-AA women (78.4 vs 72.4 kg, $P < .01$; 29.0 vs 27.6 kg/m², $P < .05$, respectively). During intervention feeding, mean (SD) kcal was 2168 (293) in AA women and 2073 (284) in non-AA women. Mean intake was 94.7 kcal higher in AA women than in non-AA women ($P < .05$). After adjustment for potential confounders, there was no difference in caloric intake between AA and non-AA women ($\beta = -2.8$ kcal, $P = .95$).

Conclusion—These results do not support the view that AA women are at greater risk for obesity because they require fewer calories to maintain weight.

Keywords

body mass index; obesity; body; energy intake weight

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Background

According to the most recent National Health and Nutrition Examination Survey (NHANES), approximately 74% of men and 64% of women are obese or overweight in the United States.¹ There are clear racial/ethnic differences in the prevalence of overweight and obesity, particularly among women. The prevalence of obesity among African American (AA) women is notably higher than that for white women (58.5% vs 32.2%).¹ Approximately 85% of AA women aged 40 years or older are overweight or obese.¹ Furthermore, AA women are 2–3 times more likely to be extremely obese than white women.¹ In weight loss trials, AA women tend to lose less weight than non-AA women.^{2–11} Potential reasons for the greater burden of obesity in AA women include environmental, physiologic, and genetic influences.^{1,11–14}

Several investigators have reported that differences in total daily energy expenditure (TDEE) or resting metabolic rate (RMR) may account for racial differences in weight.^{14–34} TDEE is the sum of an individual's resting energy expenditure (REE), thermic effect of feeding (TEF), and physical activity energy expenditure (PAEE). Obesity is usually caused by an energy imbalance, where energy intake exceeds energy expenditure.^{23,32,35–38} In a review of 15 studies, Gannon et al¹⁶ concluded that African Americans have lower RMR than whites (range, 81–274 kcal/d) after adjusting for fat-free mass and age. Carpenter and colleagues³³ observed a lower TDEE for AA women than for non-AA women. These reported differences in energy expenditure raise the possibility that AA women on average require fewer calories than non-AA women to maintain their weight. Estimation of true energy intake in a controlled setting is prudent in investigating this proposition. To date, few clinical investigators have studied associations between REE and weight in adults not engaged in weight loss, with many being cross-sectional in nature and with few participants.^{32,39} Furthermore, many studies lack precise energy intake measurements as obtaining these data has been deemed technically unfeasible in free-living individuals and therefore include dietary recall questionnaire estimates which are not always reliable.^{14,38,40–44}

The purpose of our study was to investigate whether caloric intake differs by race in the setting of a large, controlled feeding study in which weight was held constant. To our knowledge, this is the first epidemiologic, multicenter study examining racial differences in weight maintenance under standardized conditions of known energy intake in free-living individuals. On the basis of previous studies, we tested the hypothesis that AA women would require less calories to maintain weight and that this difference would persist after adjusting for potential confounders.

Methods

The Dietary Approaches to Stop Hypertension (DASH) trial was a multicenter, randomized, controlled feeding study conducted between September 1994 and January 1996 that compared the effects of 3 dietary patterns on blood pressure (BP) in individuals with prehypertension or stage 1 hypertension. Participants were recruited from 5 U.S. clinical centers (Baltimore, MD; Baton Rouge, LA; Boston, MA; Durham, NC; and Portland, OR). The study protocol was approved by the institutional review boards of all participating

centers, and written informed consent was obtained from all participants. The main results from the DASH study were published in 1997.⁴⁵ A detailed description of the methods and results of this trial has been published previously.^{45–47}

Study Participants

Participants were adults 22 years or older with a systolic BP <160 mm Hg and diastolic BP between 80 and 95 mm Hg who were not taking antihypertensive medications. Exclusion criteria included unwillingness to modify current diet, significant morbidity that would interfere with participation or assessment, and a body mass index (BMI) >35 kg/m². Because of the disproportionate burden of hypertension in the AA population, two-thirds of the participants were from a minority background. Race and ethnicity were self-reported. A total of 459 participants were enrolled in the original DASH trial. For this analysis, we studied female participants of the DASH trial (n = 206).

Conduct of the DASH Trial

Participants were sequentially enrolled in groups; the first group commenced the run-in phase of the trial in September 1994, and the fifth and last group started in January 1996. For each group, the trial was conducted in 3 phases (screening, run-in, intervention). During the screening phase, general dietary information, height and weight measurements, and nonfasting blood and urine samples were obtained. BMI as weight (in kg)/height² (in m) was calculated using height and weight measurements. During the run-in phase, all eligible participants received the control diet for a 3-week period. One goal of the run-in period was to determine the calorie intake necessary to maintain weight. The Harris-Benedict prediction formula, which takes into account age, gender, weight, and height, was used to estimate basal energy requirements or REE.⁴⁸ This method has been previously validated.⁴⁹ Participants consumed 1 meal daily at the clinical center, and food for the off-site meals was distributed. The average of weight measurements recorded during the run-in phase defined participant baseline weight and was used as the baseline against which to measure weight change during intervention feeding.

Body weight measurements were also taken daily. Randomization to 1 of the 3 diets took place during the third week. Detailed descriptions of the 3 diets, including nutrient targets, have been published.^{45–47} Briefly, the diets consisted of (1) a control diet similar to the typical American diet, (2) a diet rich in fruit and vegetables but otherwise similar to the control diet, and (3) a “combination” or DASH diet rich in fruits, vegetables, and low-fat dairy products with a reduction of saturated fat, total fat, and cholesterol. Participants were asked to maintain baseline physical activity patterns during the study. Participants ended feeding as soon as their outcome data were collected.

Controlled Feeding

A 7-day menu cycle consisting of 21 meals was used at each clinical center. Each weekday, the participants ate lunch or dinner at the site and “carried out” all foods to be consumed off-site over the next 24 hours and on weekends. Participants were required to consume only study food and to consume all food provided by the study. No more than 2 alcoholic beverages daily and no more than 3 noncaloric caffeinated beverages daily were allowed.

Outcomes

The average daily caloric (kcal) intake during the intervention phase (weeks 3–10) was the primary outcome. Participants began with 1 of 4 energy levels (1600, 2100, 2600, 3100 kcal). To maintain constant weight, staff adjusted total energy intake by changing either the calorie level of the diet or by adding diet-specific “unit” foods that provided 100 kcal each. On each day and for each participant, total calorie intake was calculated as the sum of the energy level of diet plus the number of unit foods consumed times 100 kcal. We did not include data from the run-in period because calorie intakes were commonly adjusted during this time. We also did not include data from the last week of intervention feeding, which commonly was incomplete because participants ended feeding as soon as their outcome data were collected.

Statistics

Baseline characteristics were compared by race (AA vs non-AA) with the use of Student *t* tests for continuous variables and χ^2 tests for categorical variables. To compare mean calorie levels in AA and non-AA women, we used multivariable linear regression. We present results from unadjusted models and models adjusted for baseline weight, age, alcohol consumption, income, education, diet assignment, and clinical center. We used the coefficient of determination, *R*-squared (R^2), as a goodness-of-fit measure of the strength of association between the outcome variable (average calorie level) and predictor variables.⁵⁰ All analyses were performed using STATA Version 9.0 software (StataCorp, College Station, TX). A 2-sided *P* value <.05 was considered statistically significant.

Results

Participant Characteristics

Table 1 displays demographic and lifestyle characteristics of study participants stratified by race. The study sample consisted of 206 women, of whom 151 were AA (73%). There were no statistically significant differences in educational attainment and smoking status by race. There were nonsignificant trends in age and income, with non-AA women being older than AA women (47.3 vs 44.6 years, *P* = .08) and having higher incomes (43.6% vs 35.1% in the \$30,000–\$59,000 income bracket, *P* = .09).

Average Weight

On average, AA women weighed more than non-AA women; mean (SD) weight was 78.4 (11.9) kg in AA women and 72.4 (12.9) kg in non-AA women (*P* < .01). Likewise, BMI differed by race. Throughout the run-in and intervention phases, AA women maintained higher weekly average weights than non-AA women (see Figure 1). Over the intervention phase (weeks 3–10), mean (SD) weight for AA women was 78.3 (11.8) kg and 72.2 (13.0) kg for non-AA women (*P* < .01). At the end of the intervention phase (week 10), AA women on average weighed 78.2 (11.9) kg, whereas non-AA women weighed 72.2 (12.9) kg (*P* < .01).

Average Caloric Intake

At the start of the run-in phase, mean (SD) daily caloric intake levels (kcal/d) were 2197.1 (297.0) and 2112.0 (310.3) in AA and non-AA women, respectively. Mean caloric intake levels were consistently higher in AA than in non-AA women throughout the intervention phase (2167.8 [293.4] kcal in AA and 2073.1 [283.6] kcal in non-AA women) (see Figure 2). The unadjusted difference between the 2 groups in mean daily caloric intake was 94.7 kcal/d ($P < .05$; see model 1 in Table 2).

To determine whether factors other than race accounted for this difference, a series of multivariable regression analyses were performed. After adjusting for age and baseline weight (model 2), there was no significant difference in mean daily caloric intake between AA and non-AA women (mean [SD] = 2.6 [40.2] kcal, $P = .95$). After further adjustment for income, education, alcohol intake, randomized diet assignment, and clinical center site (model 3), the association between race and calorie intake remained nonsignificant (mean [SD] = -2.8 [42.7] kcal, $P = .95$).

In contrast, caloric intake was significantly associated with baseline weight and age. For every 1-kg increase in baseline weight (model 3), average calorie levels were higher by 12.1 kcal (95% confidence interval, 9.3–15.0; $P < .01$) for all women after adjusting for race, age, education, income, alcohol consumption, diet type, and clinical center site. In a subsequent model with an interaction term of race and baseline weight (not displayed), race did not modify the relationship of baseline weight with calorie intake ($P_{\text{interaction}} = .67$). Age was significantly and inversely associated with calorie intake, such that for every 10-year increase in age, mean (SD) calorie intake was 51 (20) kcal/d lower ($P < .05$). Income, education, alcohol intake, and randomized diet were not associated with calorie intake.

Discussion

In this analysis of 206 female participants in the DASH feeding study, AA women on average required 95 kcal/d more than did non-AA women to maintain their weight. However, after adjusting for baseline weight, age, and other potential confounders, there was no difference in daily calorie intake between AA and non-AA women. This unexpected finding was inconsistent with our a priori hypothesis, that AA women require less calories/d than non-AA women to maintain weight. We did find, however, that other factors were significantly associated with calorie intake; that is, there was a direct association of calories with baseline weight and an inverse association with age.

Comparison of our results with those from other studies examining racial differences in metabolism and caloric intake in women is extremely limited because there is a paucity of published reports from longitudinal studies. A major limitation of the existing body of literature is that most studies are cross-sectional and do not provide prospective evidence about the predictive value of racial differences in metabolism and weight maintenance.^{11,12,14,16–35,40,41} Also, no randomized trials have assessed racial differentials in energy balance and weight maintenance in the setting of measured total caloric intake in free-living participants using nonsurvey methods.^{14,39,44,50,51} Tataranni and colleagues⁵² reported the only prospective study determining the association of objectively calculated

total energy intake and body weight change among free-living adult Arizona Pima Indians. Their findings were the first evidence supporting the primacy of energy intake as a determinant of obesity among this population; however, this has not been studied in other ethnic minority groups. Our data provide insight into ethnic differences in caloric requirements to maintain weight in free-living individuals. Another prospective study, in a small cohort of Jamaican adults, sought to determine whether adults with relatively low levels of PAEE gained more weight than those with higher energy expenditure.⁴⁰ No component of TDEE, including REE or PAEE, predicted weight change, suggesting that other environmental risk factors, primarily energy intake, accounted for weight gain in this population. This study lacked analysis of objective caloric intake and weight change among its participants along with comparative data to determine whether the strength of this relationship is generalizable to other groups.

One cross-sectional study in 166 free-living obese women (122 white, 44 AA) evaluated whether differences in total daily energy expenditure could explain a greater predisposition of obesity in AA women.³³ The authors used self-reported food diaries to assess energy intake and analyzed energy content using nutrition software. The AA participants reported a significantly higher energy intake than did white participants. There were no analyses of the association between dietary intake and longitudinal measurements of weight changes. However, they concluded that the excessive caloric intake in AA women may contribute to the higher incidence of obesity among this population. The authors' suggestion that AA women require fewer calories to maintain body weight is not supported by our findings through the use of precisely measured dietary intake and controlled feeding.

Among the strengths of this study is its core design—namely, a well-controlled, multicenter, outpatient feeding study with rigorous quality assurance and control. To our knowledge, this is among the first published reports examining the association of race/ethnicity with average caloric intake in a free-living population through a feeding randomized controlled trial. With repeated measurements of calorie intake and weight, the study had highly precise estimates of mean weight and mean energy intake. Last, the sample size was much larger than previous studies investigating racial differences in energy expenditure, which increased the power to detect significant associations.

The inherent limitations of the present study are well recognized. Although the original DASH trial was not designed to assess the long-term effects of dietary interventions on weight maintenance, we analyzed the data because of its robust protocol of objective monitoring of caloric intake (a component of energy balance) and weight. This avoided the potential for desirability bias from participant self-report that may occur in intervention studies.^{54–57} Moreover, the 8-week intervention phase was adequate to stabilize body weight. Also, our study did not assess REE; rather, it assessed total energy intake, a crucial component of the energy budget. Furthermore, PAEE, the most variable component of TDEE, was not measured in our study.⁵³ Only a few prospective studies among adults have this measurement due to the exorbitant expense, and it may not be reflective of physical activity patterns over an extended period.^{16,58} Most important, the relationship between PAEE and ethnicity was equivocal in these studies. As aforementioned, 2 studies demonstrated that energy intake was not predictive of weight change, TEE, or PAEE.^{40,58}

Although higher activity levels would be associated with higher energy needs to maintain weight, our study participants tended to be sedentary.

We found no significant difference in average daily caloric intake when we compared AA with non-AA women. Our findings suggest that uniform, comprehensive dietary and lifestyle modifications should be implemented for optimum weight maintenance regardless of racial background and that AA women do not need more intensive calorie restriction. Tackling the refractory nature of obesity requires dietary changes that address the interplay of biologic and environmental determinants of eating behavior. The findings of this analysis should serve as a basis for innovation in weight loss interventions stressing practicality over increased intensity among AA women.

Conclusion

In summary, the results of this study suggest that AA women do not require fewer calories to maintain weight than do non-AA women. Our findings do not support the commonly held view that AA women are at greater risk for obesity because of differences in caloric needs.

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Figure 1.
Mean weight (kg) during run-in phase (weeks 0–2) and intervention phase (weeks 3–10) by race.

Figure 2. Mean calorie level (kcal) during intervention phase (weeks 3–10) by race. * $P < .05$ for comparisons between African American women and non-African American women.

Table 1Baseline Characteristics of Participants by Race^a

Characteristic	All (n = 206)	Non-African American (n = 55)	African American (n = 151)	P Value
Age, y, mean ± SD	45.3 ± 9.7	47.3 ± 9.9	44.6 ± 9.6	.08
Baseline weight, kg, mean ± SD	76.8 ± 12.4	72.4 ± 12.9	78.4 ± 11.9	.002
Normal (59.7–76)	92 (44.7)	39 (70.9)	67 (44.4)	
Overweight (77–91.9)	74 (35.9)	10 (18.2)	64 (42.4)	
Obese (92+)	26 (12.6)	6 (10.9)	20 (13.2)	
Body mass index, kg/m ² , mean ± SD	28.6 ± 4.1	27.6 ± 4.5	29.0 ± 3.8	.03
Underweight (<18.5)	2 (1)	1 (1.8)	1 (0.66)	
Normal (18.5–24.9)	40 (19.4)	16 (29.1)	24 (15.9)	
Overweight (25–29.9)	76 (36.9)	20 (36.4)	56 (37.1)	
Obese (30+)	88 (42.7)	18 (32.7)	70 (46.3)	
Education level				.26
Less than high school	5 (2.4)	3 (5.5)	2 (1.3)	
Completed high school	36 (17.5)	7 (12.7)	29 (19.2)	
Some college	82 (39.8)	21 (38.2)	61 (40.4)	
College graduate and beyond	83 (40.3)	24 (43.6)	59 (39.1)	
Income				.09
<\$30,000	91 (44.8)	18 (32.7)	73 (49.3)	
\$30,000–59,000	76 (37.4)	24 (43.6)	52 (35.1)	
\$60,000	36 (17.7)	13 (23.6)	23 (15.5)	
Alcohol, drinks/wk, mean ± SD	0.8 ± 1.7	1.1 ± 2.0	0.6 ± 1.6	.20
Diet				.90
DASH	74 (35.9)	19 (34.5)	55 (36.4)	
Control	66 (32.0)	17 (31.0)	49 (32.5)	
Fruits and vegetables	66 (32.0)	19 (34.5)	47 (31.1)	

Values presented as No. (%) unless otherwise indicated. DASH, Dietary Approaches to Stop Hypertension.

^aThe P values compare African American women with non-African American women.

Table 2
Association of Average Calorie Levels (kcal) With Participant Demographic and Clinical Characteristics (Weeks 3–10)

Variable	Model 1 ^a ($R^2 = 0.02$)		Model 2 ^b ($R^2 = 0.33$)		Model 3 ^c ($R^2 = 0.43$)	
	Estimate (SE)	P Value	Estimate (SE)	P Value	Estimate (SE)	P Value
Race	94.7 (46.7)	.04	2.6 (40.2)	.95	−2.8 (42.7)	.95
Baseline weight, kg			12.8 (1.4)	.00	12.1 (1.4)	<.001
Age, y			−3.4 (1.8)	.07	−5.1 (2.0)	.01
Income						
<\$30,000					[Reference]	
\$30,000–\$59,000					−44.0 (41.9)	.29
\$60,000					16.3 (49.0)	.74
Education level						
Less than high school					[Reference]	
Completed high school					24.4 (115.0)	.83
Some college					53.0 (111.8)	.64
College graduate and beyond					−59.3 (113.1)	.60
Alcohol, drinks/wk					−11.9 (9.6)	.22
Diet						
DASH					[Reference]	
Control					42.2 (42.4)	.32
Fruits and vegetables					−9.8 (41.9)	.82

Similar results obtained in models with week 10 average calorie levels (kcal) as outcome variable. R^2 was calculated by the method of Magee.⁵⁰ All values in the table represent differences in average caloric intake between African American vs non-African American women. DASH, Dietary Approaches to Stop Hypertension.

^aUnadjusted.

^bAdjusted for baseline weight (kg) and age.

^cAdjusted for baseline weight (kg), age, income (<\$30,000, \$30,000–\$59,000, \$60,000), education level (less than high school, completed high school, some college, college graduate and beyond), alcohol (drinks/wk), diet type (DASH, control, fruits and vegetables), clinical center site (Baltimore, MD; Baton Rouge, LA; Boston, MA; Durham, NC; and Portland, OR; data not shown).