Total and regional body composition across age in healthy Hispanic and white women of similar socioeconomic status

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ABSTRACT

Background: Indirect measures of body composition suggest that Hispanic women have an excess prevalence of overweight and obesity compared with white women. Socioeconomic status (SES) is a potentially confounding factor in such studies.

Objective: Our aim was to determine whether Hispanic ethnicity is associated with higher total and regional adiposity and lower fat-free mass (FFM) in healthy women across the adult age range.

Design: We used a prospective cross-sectional design to examine total and regional body composition in 54 Hispanic women (primarily of Mexican descent) and 56 white women of similar SES.

Results: The groups were not significantly different in mean age, body mass, or SES, although the Hispanic women were shorter (P < 0.05). Body mass index (in kg/m²; 25.2 ± 0.5 compared with 23.9 ± 0.5; P < 0.05), percentage body fat (38.4 ± 0.8% compared with 34.9 ± 1.3%; P < 0.05), and total fat mass (25.0 ± 1.0 compared with 23.0 ± 1.2 kg; P = 0.10) were or tended to be higher in the Hispanic women. The greater total adiposity of the Hispanic women was primarily the result of percentage fat and fat mass in the trunk (P < 0.05); within the trunk region, abdominal and subscapular skinfold thicknesses were 30–40% greater in the Hispanic women (P < 0.01). Total FFM was slightly but significantly lower in the Hispanic women (38.9 ± 0.6 compared with 40.9 ± 0.6 kg; P = 0.01), primarily because of a smaller FFM in the trunk region (P < 0.05).

Conclusion: Among healthy women, Hispanic (Mexican American) ethnicity may be associated with modestly higher levels of adiposity and slightly lower amounts of FFM overall and in the trunk region in particular.

KEY WORDS Adiposity, body fat, fat-free mass, Mexican Americans, women, body composition, socioeconomic status, ethnicity

INTRODUCTION

Age-related elevations in whole-body and central adiposity are associated with an increased prevalence of chronic degenerative diseases, particularly type 2 diabetes (1–3). This is the case in Hispanic adults, who have higher levels of body fatness and type 2 diabetes than do their white peers (4–9).

Indirect measures of whole-body adiposity such as body mass index (BMI) generally increase with age in Hispanic adults (5, 10). At least up to age 60 y, BMI and the prevalence of overweight and obesity are reported to be higher in Hispanic adults than in white adults (4, 5, 10–12). Importantly, these postulated ethnicity-associated differences in adiposity are much greater in women than in men (4, 11, 13).

Limited data from studies in which more direct measures of total body composition were used support these observations. Percentage body fat and total fat mass were observed to be higher, and fat-free mass (FFM) lower, in Hispanic women than in white women (14–16). Moreover, indirect measures of central adiposity such as the waist-to-hip ratio and the subscapular-to-triceps skinfold thickness ratio were also reported to be greater in Hispanic than in white women (13, 14, 17).

A serious potential confounder in the interpretation of these results, which may pertain to Hispanic ethnicity per se, is socioeconomic status (SES). In most cases, the Hispanic women studied to date were of lower or unspecified SES compared with their white counterparts. However, measures of adiposity and overweight were shown to be inversely related to SES in Hispanic women, (12, 18). Indeed, differences in BMI between Hispanic and white women become smaller with increasing SES (11, 19). Thus, true ethnicity-dependent differences in total and regional body composition cannot be determined when such differences in SES are present.

The greater Boulder, CO, region has a population with an overall largely high SES and a significant Hispanic minority group. In the present study, we took advantage of the opportunity provided by this unique demographic profile to study groups of...
TABLE 1
Subject characteristics

<table>
<thead>
<tr>
<th></th>
<th>White women</th>
<th>Hispanic women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>45 ± 2</td>
<td>42 ± 2</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>164 ± 1</td>
<td>160 ± 1</td>
</tr>
<tr>
<td>Body mass (kg)</td>
<td>64.4 ± 1.3</td>
<td>64.5 ± 1.4</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.9 ± 0.5</td>
<td>25.2 ± 0.5</td>
</tr>
<tr>
<td>SES (y of education)</td>
<td>16.4 ± 0.3</td>
<td>16.6 ± 0.5</td>
</tr>
<tr>
<td>BMD (g/cm²)</td>
<td>1.18 ± 0.01</td>
<td>1.16 ± 0.01</td>
</tr>
<tr>
<td>Physical activity (kJ·kg⁻¹·d⁻¹)</td>
<td>143 ± 1</td>
<td>146 ± 1</td>
</tr>
<tr>
<td>Physical activity (kcal·kg⁻¹·d⁻¹)</td>
<td>34.2 ± 0.2</td>
<td>34.9 ± 0.3</td>
</tr>
</tbody>
</table>

1 ± SE. SES, socioeconomic status; BMD, bone mineral density.

2 Significantly different from white women, P < 0.05.

healthy Hispanic and white women of various ages who were of similar SES. Using this cross-sectional approach, we asked the basic experimental question of whether Hispanic ethnicity is associated with higher total and central adiposity and lower FFM in healthy women across the adult age range.

SUBJECTS AND METHODS

Subjects

We studied 110 healthy sedentary women aged 20–75 y: 54 women were Hispanic and 56 were white. Subjects were recruited primarily from the greater Boulder County, CO, area from churches and community centers and through newspaper advertisements and posted flyers. Ethnicity was determined by asking subjects to which ethnic group they belonged. Those who stated “Caucasian, white, or non-Hispanic white” were considered white and those who chose “Mexican/Mexican American, Central American, or South American” were considered Hispanic as described recently by Winkleby et al. (11). Hispanic women also volunteered whether they or their parents or grandparents were born in Mexico, Central America, or South America. Eighty-nine percent of the Hispanic subjects were of Mexican descent.

All subjects were healthy as assessed by medical history. Subjects aged ≥50 y were further evaluated for clinical evidence of cardiopulmonary disease with a physical examination and electrocardiograms during rest and maximal exercise. The subjects were nonsmokers and were not taking any medications regularly. Six (18%) of the Hispanic women and 8 (15%) of the white women were taking estrogen-based hormone supplements. The nature, purpose, and risks of the study were explained to each subject in English or Spanish, as needed, before written, informed consent was obtained. The experimental protocol was approved by the Human Research Committee at the University of Colorado at Boulder.

Body mass and composition

Total body mass was measured to the nearest 0.1 kg on a physician’s balance scale (Detecto, Webb City, MO). BMI was calculated from mass and height (kg/m²). Total body composition was measured by using dual-energy X-ray absorptiometry ([DXA] DXA-IQ, software version 4.1; Lunar Radiation Corp, Madison, WI). DXA scans were used to measure fat mass, lean tissue mass, and bone mineral density. Regional (arm, trunk, and leg) fat and lean tissue were measured by using the extended research analysis of the LUNAR software (20). Scans were performed either before or ≥3 h after a meal. Skinfold thicknesses were measured to the nearest 1 mm at 5 sites (triceps, suprailium, subscapula, abdomen, and thigh) by a single investigator using Lange calipers (Cambridge Scientific, Cambridge, MD); the average of 3 measurements was used (21). Minimal waist circumference was measured according to guidelines published previously (21).

Socioeconomic status

Education (calculated as the highest number of completed school years) was used as a measure of SES because this was shown to be more closely associated with risk factors for chronic disease than was income or occupation (22–24).

Habitual physical activity

Habitual physical activity was estimated from measures of daily energy expenditure by using the Stanford Physical Activity Questionnaire (25) as used previously in our laboratory (26).

Statistics

Group differences between Hispanic and white women for all variables of interest were determined by analysis of variance or analysis of covariance (ANCOVA). Linear regression analyses were used to examine relations between dependent variables of interest and subject age. Pearson’s product-moment correlation coefficients were used to express the direction and magnitude of the relations. The slopes of regression lines were compared by using ANCOVA. Data are expressed as means ± SEs. The level of absolute statistical significance was set at P < 0.05, with suggested (tendency for) significance at P < 0.1. The computer program STATVIEW was used to perform the analyses (version 5.0; SAS Institute Inc, Cary, NC).

RESULTS

Subject characteristics

Selected subject characteristics are shown in Table 1. There were no significant group differences in age, body mass, SES, or estimated habitual physical activity. However, the Hispanic women were shorter than the white women. Body mass tended to increase with age in the white women (r = 0.30, P = 0.07) but not in the Hispanic women (r = 0.12, P = 0.38).

Total and regional body fat: relation to ethnicity

BMI was ~5% higher in the Hispanic women than in the white women (25.2 ± 0.5 compared with 23.9 ± 0.5; P < 0.05). Total percentage body fat also was higher in the Hispanic women (34.2 ± 1.7-kg greater trunk fat mass and a tendency for a higher arm fat mass (Figure 1). This was explained by a greater percentage fat in the arms and trunk in the Hispanic women (Figure 1). There were no significant group differences in percentage fat in the legs between the Hispanic and the white women (43.5 ± 0.9% compared with 41.5 ± 1.3%, respectively).

Total fat mass was ~9% (2 kg) higher on average in the Hispanic women than in the white women (Figure 2). This higher mean total fat mass in the Hispanic women was primarily due to an ~1.7-kg greater trunk fat mass and a tendency for a higher arm fat mass (Figure 2). Leg fat mass was not significantly different between the Hispanic and the white women (10.2 ± 0.4 compared with 10.3 ± 0.5 kg, respectively).
Total and regional body fat: relation to age

Total percentage body fat and total fat mass generally were positively related to age in both the Hispanic (r = 0.20–0.31, P = 0.10–0.02) and the white (r = 0.40–0.45, both P < 0.01) women. Trunk percentage fat and fat mass increased with age in both the Hispanic (r = 0.33–0.42, both P ≤ 0.01) and the white (r = 0.41–0.45, both P < 0.01) women, as did arm percentage fat and fat mass (Hispanic: r = 0.30–0.36, P = 0.06–0.007; white: r = 0.40–0.50, both P < 0.01). Leg percentage fat and fat mass increased significantly with age only in the white women (Hispanic: r = 0.04–0.05, P = 0.70–0.77; white: r = 0.30–0.39, both P < 0.05). In general, the higher mean total, truncal, and arm adiposity in the Hispanic women than in the white women were due to greater adiposity in the young and early-middle age ranges; group differences tended to become smaller with increasing subject age. These patterns of adiposity across age were also observed for regional skinfold thicknesses and waist circumference in the 2 groups.

Total and regional FFM

Total FFM was 5% (≈2 kg) lower in the Hispanic women than in the white women (Figure 3). Total FFM decreased modestly with age in the white women (r = −0.31, P < 0.05) but not in the Hispanic women (r = −0.10, P = 0.55). The smaller total FFM in the Hispanic women was due to correspondingly smaller FFM in the trunk (−1.0 kg, P < 0.05), arms (−0.3 kg, P < 0.05), and legs (−0.7 kg, P < 0.05) than in the white women. As with adiposity, the smaller total and regional FFM in the Hispanic women than in the white women was due primarily to differences in the young and early-middle age ranges; these differences became smaller with increasing age.

Age and menopause effects

The distributions of premenopausal and postmenopausal women were similar in the Hispanic and the white subject groups. There were no ethnicity × menopausal status (pre- or postmenopausal) interactions for any body-composition variable. There were main effects for menopausal status, but these were the same as those presented above for age.

DISCUSSION

We found that among healthy women aged 20–75 y, Hispanic women (who were primarily of Mexican descent) tended to have slightly greater levels of total adiposity than did their white peers. The higher mean amounts of total body fat in the Hispanic women were due primarily to an ≈20% greater amount of fat in
the trunk region. Because body mass was not significantly different between the 2 groups, the slightly greater total and truncal adiposity in the Hispanic women was associated with correspondingly lower amounts of total and truncal FFM. Importantly, the Hispanic and the white women did not differ significantly in SES, a potentially confounding factor in the interpretation of population differences in body composition. Accordingly, our results suggest that among healthy women in a wide age range, Hispanic (primarily Mexican American) ethnicity per se may be associated with modestly higher amounts of adiposity and slightly lower amounts of FFM both overall and in the trunk region in particular.

The differences in BMI between the Hispanic and the white women in the present study are within the range of values reported previously for women matched for various levels of education by Winkleby et al (11, 19). With regard to more direct measures of total adiposity, in healthy women aged 20–30 or 40–50 y with BMIs <27.3, Thomas et al (15) reported much lower absolute amounts of body mass (58–60 kg), percentage body fat (25–28%), and total fat mass (16–19 kg) (as calculated by hydrostatic weighing and total body potassium) than in the present study. However, the 3–5% greater total body fat units and the ≈2.5 kg greater total fat mass in their Mexican American women were similar to the mean group differences observed in the present study. No measures of SES were reported by Thomas et al (14, 15).

In addition to controlling for the potentially confounding effects of differences in SES, the present study extends previous observations by determining the body regions responsible for these ethnicity-associated differences in total adiposity. Specifically, regional analysis of the whole-body DXA scans indicated that most (ie, 85%) of the higher mean amount of total fat mass was due to a greater truncal fat mass in the Hispanic women. When the effects of these differences were accounted for statistically, the ethnicity-related group differences in total adiposity were abolished.

In the present study, we also found that total FFM was slightly but significantly lower (≈5%, or 2.1 kg) in the Hispanic group than in the white group. A lower total FFM in Hispanic women than in white women was reported previously by Thomas et al (15). Thus, together, these findings support the idea that healthy women of Mexican American descent have on average a slightly smaller total FFM than do white women. However, our results extend the previous findings of Thomas et al in 2 important ways. First, our data indicate that these differences are observed even after the possible influence of SES is accounted for and, therefore, appear to be associated with Hispanic ethnicity per se. Second, our results show that ≈50% of the lower total FFM in
Hispanic women was due to a smaller FFM in the trunk, whereas lower amounts of FFM in the legs also contributed significantly. In our sample of healthy women, total and regional fat mass tended to increase with age, whereas FFM tended to decrease. However, the relations with age generally were more consistently observed in the white women than in the Hispanic women. In fact, in the subject groups of Hispanic and white women of similar SES, the ethnicity-related differences in body composition were primarily the result of differences in the young adult to early middle-aged women. Hispanic-white differences in specific measures of adiposity and FFM tended to be smaller with increasing subject age to the point that in many cases, no differences were observed at older ages (ie, the regression lines merged). Thus, our findings suggest that in healthy women of similarly high educational status, differences in total and regional body composition associated with Hispanic ethnicity may occur primarily in early adulthood.

Four experimental limitations of the present study should be mentioned. First, our subject samples consisted of only healthy women. If women with clinically documented disease, including severe obesity, had been studied, our results may have been different. Second, although >100 women were included, it is likely that the tendency for group differences in some measures of adiposity (eg, total fat mass) would have been significant had we been able to study more subjects (ie, there is the possibility of a type II error). However, we were limited by the availability of Hispanic women of sufficiently high SES to compare with the regional population of white women. We simply were unable to identify additional Hispanic women within the required SES range. Third, the Hispanic women studied were primarily (>90%) of Mexican American descent. As such, our findings cannot be generalized to Hispanic women of other descent. Finally, it is possible that measurement error associated with our DXA assessments of body composition account for some or all of the ethnic differences observed. The measurement errors for DXA estimates of percentage body fat, fat mass, and lean tissue are <1.4%, 1.0 kg, and 0.8 kg, respectively (20). However, the mean ethnic group differences in these measures were 2- to 3-fold greater than the corresponding measurement errors. This suggests that our differences cannot be completely explained by this factor.

The present findings may have important physiologic and clinical implications regarding Hispanic ethnicity and body composition. For example, as emphasized earlier, elevated total and central adiposity are associated with increased morbidity and premature mortality from several chronic degenerative diseases (1–3). Moreover, reduced FFM is associated with impaired physical functional capacity (ability to perform the tasks of daily living), especially in older adults (27, 28). Our results suggest that,
at least among healthy women, Hispanic ethnicity may be independently associated with elevated adiposity and reduced FFM as a result of genetic predisposition, cultural factors, or both.

In conclusion, the results of our study provide experimental support for the concept that among healthy women, Hispanic ethnicity may be associated with modestly elevated total adiposity and lower total FFM. These whole-body differences appear to be primarily the result of body-composition differences in the trunk region. These findings may have important implications for disease prevention and maintenance of functional capacity with advancing age in Hispanic women.

REFERENCES