美國少數民族的身體組成

Body composition of ethnic groups in the US

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Total body composition has not been reported from national samples of ethnic groups in the US but the data being recorded in the Third National Health and Nutrition Examination Survey include anthropometric variables and bioelectric impedance that jointly would allow the prediction of fat-free mass and other body composition variables for individuals. If these values were used in combination with the sample weighing coefficients, they could provide national estimates for composition values in whites, Afro-Americans and Hispanic-Americans. Despite the limitations of the reports currently available, data from relatively large groups will be summarised and ethnic comparisons will be made taking into account the procedures by which the data were obtained. Data for regional body composition, mainly skinfold thicknesses and circumferences, are much more plentiful. They allow the evaluation of possible secular trends and of fat patterning within ethnic groups and the possible interplay of genetic and environmental influences.

Introduction

The major ethnic groups in the US are whites, blacks and Hispanic Americans but there is considerable ethnic diversity within each of these groups. This diversity is partly genetic in origin and partly due to environmental effects including those due to particular behaviours, eg tobacco use, and those due to socio-economic influences. Ethnicity is by self-report in almost all studies. This is a cultural classification, not a genetic one. Self-reporting of ethnicity is not the ideal and it may change due to inter-ethnic marriages.

There are some rapid alterations within US ethnic groups due to marked migration from south east Asia, India and Mexico. This increases the number of whites and Hispanic Americans when the population is classified into only the three ethnic groups. Furthermore, this migration adds individuals to the existing ethnic groups who have not been exposed to the US environment for long periods. This complicates the interpretation of possible differences between ethnic groups.

There is a lack of studies of total body composition in nationally representative US samples but there are national reference data for regional measures, particularly skinfold thicknesses. These national reference data are available for whites (including Hispanic Americans) and blacks[1] and for a large but not nationally representative sample of Mexican Americans.

Total body composition

The reports included in this review were selected on the basis of the methods used and the sample sizes. Studies that include more than one ethnic group are particularly important in the present context. In boys and young men, there is a gradation in percent body fat (%BF) from low values in blacks to intermediate values in Mexican Americans and high values in whites (Table 1)[2-4]. The corresponding information for fat-free mass is limited to two reports: these indicate that values are markedly larger in whites than in Mexican Americans, but much of this difference may be due to age differences between the samples that have been studied.

Table 1. Body composition in US boys and young men (mean;sd).

Author	Ethnicity	Age (years)	*n*	%BF	FFM(kg)
Slaughter et al.[2]	White[b]	8-18	85	17.0 (7.0)	–
	Black	8-18	46	12.5 (5.9)	–
Guo et al.[3]	White[b]	7-25	140	15.7 (7.5)	46.5 (15.2)
Zavaleta & Malina[4]	Mexican American[a]	9-14	95	14.1 (5.2)	30.7 (7.2)

[a]two-component model; [b]multi-component model.

In middle-aged and older men, there is lack of concordance among reports for whites and blacks[5–7] (Table 2). These differences may be partly due to the inclusion of many athletes in the study by Vickery[5] and the inclusion of older individuals in the study by Zillikens and Conway[6]. It can be tentatively concluded that the white–black difference in %BF decreases with age. The difficulties of interpretation are clear when values for whites aged about 50 years are compared among studies;[7–9] much lower values were reported by Wang[7] than by Novak[8] and Borkan and Norris[9]. There are only small differences between values for Asians, whites and blacks at mean ages of 45–51 years[7]. There are few reports of fat-free mass (FFM)[5,8–10]. Vickery[5] reported higher values for blacks than whites which may reflect the inclusion of some athletes. In cross-sectional data for whites, FFM decreases after 45 years[8] or 64 years[9].

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Table 2. Body composition in men (mean; sd).

Author	Ethnicity	Age (years)	*n*	%BF	FFM (kg)
Vickery et al.[5]	White[a]	18–32	179	14.9 (5.2)	66.9 (11.4)
	Black	18–32	140	10.6 (6.5)	71.7 (10.7)
Zillikens & Conway[6]	White[b]	20–61	47	18.6 (5.7)	–
	Black	19–50	45	19.7 (7.1)	–
Wang et al.[7]	White[a]	50 (18)	166	18 (7)	–
	Black	45 (16)	64	18 (7)	–
	Asian	51 (20)	99	19 (7)	–
Novak[8]	White[c]	18–25	27	17.8 (8.1)	59.5 (6.7)
	White	25–35	58	21.7 (6.8)	60.6 (5.9)
	White	35–45	33	22.8 (5.0)	60.4 (8.3)
	White	45–55	37	27.4 (6.1)	55.4 (6.2)
	White	55–65	42	27.9 (5.8)	53.0 (6.4)
Borkan & Norris[9]	White[b]	25–34	53	25.1	59.7
	White	35–44	105	26.4	56.8
	White	45–54	134	27.5	56.5
	White	55–64	102	26.8	57.7
	White	65–74	85	27.9	54.6
	White	75–84	19	26.7	52.3
Jackson & Pollock[10]	White[a]	33 (11)	308	17.7 (8.0)	63.9 (7.4)
Guo et al.[e]	White[d]	25–54	32	23.0 (5.7)	–

[a]two-component model; [b]from total body water; [c]from total body potassium; [d]four-component model; [e]unpublished data.

Table 3. Percent body fat in girls and young women (mean; sd).

Author	Ethnicity	Age (years)	*n*	%BF
Slaughter et al.[2]	White[a]	8–18	63	23.7 (6.3)
	Black	8–18	45	23.5 (6.0)
Guo et al.[3]	White[a]	7–25	110	24.8 (7.4)

[a]multi-component model.

Table 4. Percent body fat in women (mean, sd).

Author	Ethnicity	Age (years)	*n*	%BF
Zillikens & Conway[6]	White[a]	20–57	42	28.3 (6.6)
	Black	19–44	45	28.9 (8.1)
Ortiz et al.[11]	White[a,d]	24–79	19 pairs	28.9 (5.9)
	Black			27.9 (7.3)
Wang et al.[7]	White[c]	50 (19)	212	23 (7)
	Black	45 (15)	48	26 (7)
	Asian	51 (27)	109	26 (7)
Novak[8]	White[b]	18–25	89	33.0 (5.3)
	White	25–35	33	32.0 (8.7)
	White	35–45	44	35.9 (7.6)
	White	45–55	72	42.7 (7.8)
	White	55–65	54	43.5 (7.2)
Tran & Weltman[12]	White[c]	20–29	82	30.1 (8.6)
	White	30–39	108	35.1 (10.1)
	White	40–49	102	37.1 (7.6)
	White	50–59	80	39.4 (6.7)
	White	60–69	20	43.4 (8.2)
Pollock et al.[13]	White[c]	32 (11)	249	24.1 (7.2)

[a]from total body water; [b]from total body potassium; [c]two-component model; [d]matched for age, weight and stature.

In girls and young women, there are only small differences between ethnic groups in %BF[2,3](Table 3). In middle-aged women, Zillikens and Conway[6] reported only small differences in %BF between blacks and whites (Table 4). A similar conclusion was reached by Ortiz et al.[11] who studied matched pairs. Wang et al.[7], however, reported considerably lower values for whites than for blacks or Asians. In whites, %BF increases with age in cross-sectional data[8,12–13]. It should be noted also that the values for whites differ markedly among studies, as is the case for men. This sampling variability leads one to place more trust in studies that have included more than one ethnic group.

The relationship of body density to anthropometric values differs between whites and blacks in ways that suggest total body bone mineral (TBBM) is greater in blacks than whites[14–15]. This has been confirmed by photon absorptiometry. Additionally it has been shown that TBBM is higher in white men than in Asian men[16]. Differences in TBBM between black and white women remain after adjustments for weight and stature[17] but the corresponding differences between Asians and whites are eliminated by such adjustments[16] (Table 5).

Table 5. Total body bone mineral (g).

Author	Ethnicity/ sex (m/f)	Age (years)	*n*	TBBM (g)
Russell-Aulet et al.[16]	White m	50	154	3040 (532)
	Asian m	51	84	2697 (421)
Cote & Adams[17]	White f	18–30	26 pairs[a]	2718 (321)
	Black f			3021 (305)

mean (sd).
[a]matched for age, weight, stature and sum of skinfolds.

Regional body composition

Although subject to criticism as an index of adipose tissue distribution, the waist-hip ratio (WHR) is important because of its relationship to cardiovascular diseases[18]. For men, WHR values are generally larger in whites than in blacks and are larger still in Mexican Americans[19–22] (Table 6). Croft et al.[22], however, reported rather large values for black men. In women, WHR values are slightly larger in blacks than in whites until 30 years[19–20]; reports are lacking for black/white comparisons at older ages (Table 7). Values for Mexican American women markedly exceed those for whites at all ages from 25–64 years[21]. In girls, grouped by stage of sexual maturity, WHR values are relatively high in Asians for groups at stages 1 and 2 combined, but are somewhat low at stage 4 compared with whites and blacks[23] (Table 8). There are only slight differences between white and Hispanic pubescent girls in WHR values.

Table 6. Waist-to-hip ratio in men (mean; sd).

Author	Ethnicity	Age (years)	*n*	Waist-to-hip ratio
Slattery et al.[19]	White	18–30	1157	0.84 (0.001)
	Black	18–30	1134	0.82 (0.001)
Kaye et al.[20]	White	25	1159	0.84 (0.05)
	Black	24	1142	0.82 (0.04)
Haffner et al.[21]	White	25–34	29	0.86
	Mex. Am.	25–34	107	0.91
	White	35–44	29	0.95
	Mex. Am.	35–44	73	0.94
	White	45–54	15	0.95
	Mex. Am.	45–54	57	0.96
	White	55–64	28	0.95
	Mex. Am.	55–64	50	0.96
Croft et al.[22]	Black	25–50	655	0.89 (0.004)

Possible ethnic differences in adipose tissue distribution, indexed by WHR or other measures, may be genetic in origin[24] but they are also associated with physical activity, alcohol and tobacco use, reproductive history, estrogen replacement and socio-economic status[25–28]. It has been suggested that a central deposition of adipose tissue is a response to stress acting through the adrenal cortex[29].

Table 7. Waist-to-hip ratio in women (mean; sd).

Author	Ethnicity	Age (years)	*n*	Waist-to-hip ratio
Slattery et al.[19]	White	18–30	1286	0.73 (0.001)
	Black	18–30	1393	0.74 (0.002)
Kaye et al.[20]	White	25	1300	0.73 (0.05)
	Black	24	1464	0.74 (0.06)
Haffner et al.[21]	White	25–34	27	0.76
	Mex. Am.	25–34	128	0.81
	White	35–44	22	0.79
	Mex. Am.	35–44	111	0.83
	White	45–54	23	0.81
	Mex. Am.	45–54	113	0.83
	White	55–64	43	0.82
	Mex. Am.	55–64	86	0.89
Croft et al.[22]	Black	25–50	1101	0.85 (0.003)

Table 8. Waist-to-hip ratio in girls grouped by sexual maturity (mean; sd).

Author	Ethnicity	Age (years)	*n*	Waist-to-hip ratio
	Sexual maturity stage 1 and 2			
Hammer et al.[23]	White	11.8	34	0.77 (0.05)
	Hispanic	11.8	14	0.76 (0.04)
	Asian	12.0	34	0.79 (0.04)
	Sexual maturity stage 3			
	White	12.1	101	0.74 (0.04)
	Hispanic	12.0	50	0.75 (0.04)
	Asian	12.4	66	0.75 (0.05)
	Sexual maturity stage 4			
	White	12.5	157	0.74 (0.05)
	Hispanic	12.6	86	0.75 (0.05)
	Asian	12.7	52	0.73 (0.05)
	Sexual maturity stage 5			
	White	13.0	54	0.74 (0.05)
	Hispanic	13.2	35	0.72 (0.05)

Skinfold thickness and arm muscle area

In low socio-economic groups of infants measured a few days after birth, triceps skinfold thicknesses were lower in Puerto Ricans than in whites and blacks but arm muscle areas were larger in blacks than in Puerto Ricans and whites[30]. An interesting study of 1093 immigrant children in California aged 6–12 years showed the medians for triceps skinfold thicknesses and arm muscle areas for Hispanic migrants were similar to US reference data but those for south east Asians, Chinese and Filipino migrants were low[31]. Data for the duration of residence in the US were not available.

Analyses of data from NCHS surveys show that, in each gender, the median triceps skinfold thicknesses are similar in whites and Mexican Americans to 18 years but are considerably lower for blacks[32]. At the subscapular site, the ethnic differences are less marked but the values for Mexican Americans are higher than those for whites and blacks after nine years in boys and 11 years in girls. Comparisons in adults are restricted to whites and blacks[1]. These show only small differences in median triceps and subscapular skinfold thicknesses for men but the medians for black women consistently exceed those for whites from 25–70 years. These ethnic differences are more marked for subscapular skinfold thicknesses. These data, in combination with arm circumference, have been used to compare the cross-sectional areas of fat (adipose tissue) and muscle (including bone) in the arm from 1–70 years. In males, the mean fat areas are slightly larger in blacks than whites at all ages and there is a similar ethnic difference for females but only at ages older than 13 years (Fig. 1). Mean arm muscle areas do not show black/white ethnic differences until ages older than 12 years when the values for blacks are slightly lower than those for whites (Fig. 2).

Some interesting comparisons between white and Mexican-American children and youth have been reported for the body mass index (BMI) (weight/stature^2)[33]. In comparison with whites, the 90th percentiles for Mexican Americans are high from 1 through 18 years and all the percentiles are high in girls after 11 years. These findings are associated with short statures for Mexican Americans after 13 years in boys and 11 years in girls; these deficiencies in stature are more marked in girls than in boys. It is unclear whether the deficiencies in the statures of Mexican Americans, which affect BMI, are due to genetic or environmental influences. This is important in relation to the development of ethnic-specific growth charts

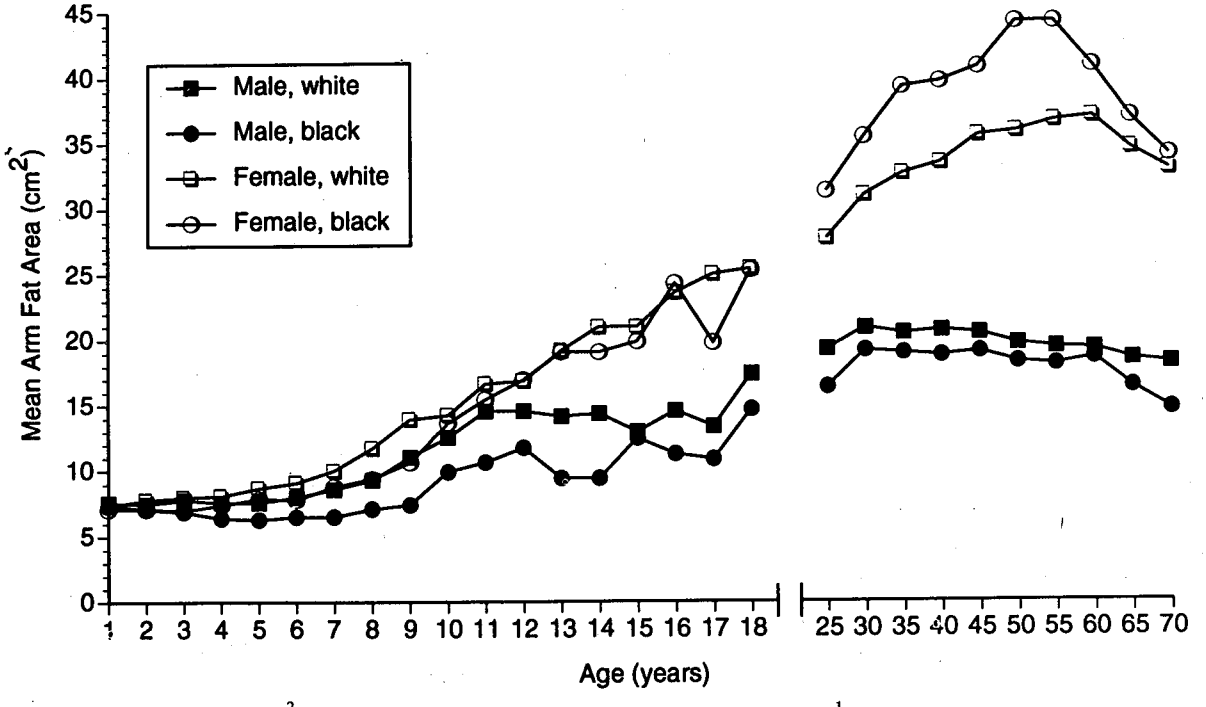

Figure 1. Mean arm fat areas (cm^2) for whites and blacks 1–70 years from US national surveys[1].

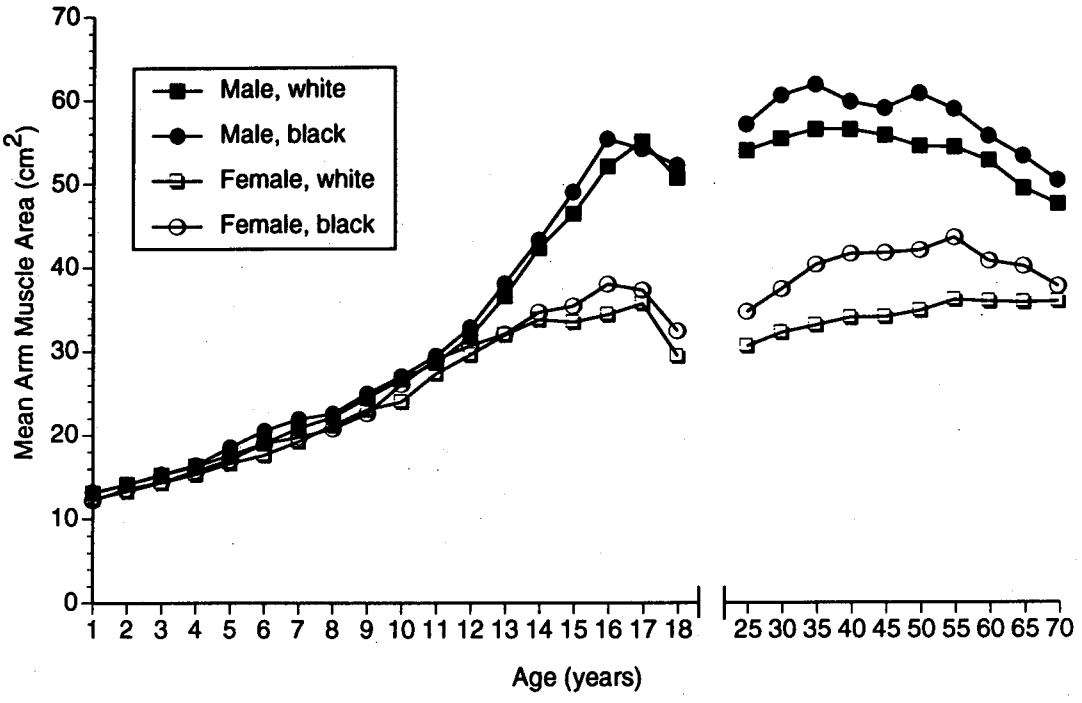

Figure 2. Mean arm muscle areas (cm^2) for whites and blacks 1–70 years from US national surveys[1].

which can be justified only if there are substantial differences among ethnic groups that are genetically determined.

Conclusion

There is reason for dissatisfaction upon reviewing the current state of knowledge concerning ethnic differences in body composition within the US. Some improvement may occur. The current NCHS survey will provide data for probability samples of blacks and Hispanic Americans and will lead to national estimates for measures of regional body composition. Since bioelectric impedance is being measured in those older than 12 years in this survey, predictive equations could be applied to obtain national distributions of predicted values. There are, however, very few predictive equations that have been developed using modern statistical techniques and that have been fully cross-validated[3,34]; those that exist are restricted to whites. Cross-validation requires that (1) the dependent and independent variables be measured in the same way, ideally in different laboratories, (2) the root mean square errors (RMSE) are small, and (3) the RMSE do not vary systematically with age, obesity or body size.

Despite the limitations of the available data, some tentative conclusions are possible. In males aged less than 25 years, %BF appears to be relatively low in blacks, high in whites and intermediate in Mexican Americans. In older men and in females of all ages, the ethnic differences in %BF at the median level appear to be small. After adjusting for weight and stature, TBBM is greater in blacks than whites: this affects the estimation of body composition and is associated with a lower prevalence of fractures in blacks[35]. The distributions of subcutaneous adipose tissue differ between blacks and whites, particularly at the subscapular site in women. This suggests that black women may have more truncal adipose tissue which may be related to the greater prevalence of diabetes mellitus and hypertension in blacks compared with whites[36].

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