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Body fat differences among U.S. youth aged 8–19 by race and Hispanic origin, 2011–2018

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Abstract

Background: The association between body mass index (BMI) and adiposity differs by race/ethnicity.

Objective: To examine differences in adiposity by race/Hispanic origin among US youth and explore how those differences relate to differences in BMI using the most recent national data, including non-Hispanic Asian youth.

Methods: Weight, height, and DXA-derived fat mass index (FMI) and percentage body fat (%BF) from 6923 youth 8-19y in the National Health and Nutrition Examination Survey (NHANES) 2011-2018 were examined. Age-adjusted mean BMI, FMI and %BF were reported. Sex-specific linear regression models predicting %BF and FMI were adjusted for age, BMI category and BMI category*race/Hispanic origin interaction.

Results: %BF was highest among Hispanic males (28.2%) and females (35.7%). %BF was lower among non-Hispanic Black (23.9%) compared with non-Hispanic White (26.0%) and non-Hispanic Asian (26.6%) males. There was no difference between non-Hispanic Black females

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(32.7%) and non-Hispanic White (33.2%) or non-Hispanic Asian (32.7%) females. FMI was higher among Hispanic youth compared with non-Hispanic White youth. Among youth with underweight/healthy weight, predicted %BF and FMI were lower among non-Hispanic Black males (−2.8%; −0.5) and females (−2.0%; −0.3), compared with non-Hispanic White youth, and higher among Hispanic males (0.9%; 0.2) and females (2.0%; 0.5), while %BF but not FMI was higher among non-Hispanic Asian males (1.3%) and females (1.4%). Among females with obesity, non-Hispanic Asian females had lower %BF (−2.3%) and FMI (−1.7) than non-Hispanic White females.

Conclusions: Differences in %BF and FMI by race/Hispanic origin were not consistent by BMI category among U.S. youth in 2011-2018.

Keywords

adiposity; percentage body fat; fat mass index; DXA; dual-energy X-ray absorptiometry; NHANES

Introduction

Body mass index (BMI; in kg/m^2) is commonly used to define obesity both clinically and in population-based studies. However, BMI is not a direct measure of adiposity and studies have shown differences in the association between BMI and adiposity by BMI category, age, race/ethnicity, and health risk.[1-9] Among children and adolescents, BMI does not estimate adiposity well among children with lower BMI, when compared with direct measures of adiposity.[10, 11] BMI has a stronger association with adiposity at higher levels of body fatness.[4]

Differences in obesity prevalence among U.S. youth by race and Hispanic origin have been well reported.[12-17] Studies have found higher obesity prevalence among Hispanic and non-Hispanic Black youth, compared with non-Hispanic White and non-Hispanic Asian youth.[14, 15] There are fewer nationally representative studies of disparities among U.S. youth using directly measured adiposity, and none have included analyses that compared Asian youth to other groups. Previous studies have examined percentage body fat (%BF) and fat mass index (FMI; in kg/m^2) measured with dual-energy x-ray absorptiometry (DXA) among youth by race and Hispanic origin using data from the 1999–2004 National Health and Nutrition Examination Survey (NHANES).[1, 18, 19] Flegal et al. (2010) compared %BF and BMI-for-age by race and Hispanic origin among non-Hispanic White, non-Hispanic Black, and Mexican American children and adolescents and found that the prevalence of high BMI, but not high adiposity, was significantly higher among non-Hispanic Black females compared with non-Hispanic White females.[1] In a separate study, FMI z score was higher among Mexican American males than non-Hispanic White and non-Hispanic Black males and higher among non-Hispanic Black than non-Hispanic White males.[20] No difference in FMI z score by race and ethnicity was seen among females.[20]

The current study supplements previous analyses by using recently-released DXA data from NHANES 2011–2018, by including non-Hispanic Asian youth (who could not be analyzed separately in earlier nationally-representative NHANES data), and by examining differences in FMI; in addition to %BF and BMI. FMI is useful as an additional direct measure of adiposity because it directly compares fat mass adjusting for height, while differences in %BF between individuals may reflect differences in fat mass, fat-free mass, or both.[21] Compared with FMI, the use of %BF alone may underestimate adiposity among those with high lean body mass.[20] The objectives of this study were to examine differences in DXA-measured %BF and in DXA-measured FMI during 2011–2018 by race and Hispanic origin among U.S. children and adolescents aged 8–19 years, hereafter termed youth, and to explore how differences in adiposity relate to differences in BMI.

Methods

Analyses were conducted using data from NHANES. NHANES is a nationally representative cross-sectional survey of the U.S. civilian non-institutionalized population, which includes both interview and physical examination components. NHANES uses a complex, multistage sampling design and has been conducted continuously since 1999 with data released in two-year cycles, most recently for 2017–2018.[22] Recently-released DXA data from four survey cycles (2011–2012, 2013–2014, 2015–2016, and 2017–2018) were combined for this study in order to improve precision of the estimates.

The National Center for Health Statistics Research Ethics Review Board approved NHANES protocols. Youth aged 8–17 years provided written assent and parents or guardians provided written consent. Participants aged 18 years and over provided written consent. NHANES examination response rates for youth aged 6–19 were 76.8% during 2011–2012, 76.2% during 2013–2014, 64.7% during 2015–2016, and 54.3% during 2017–2018.[23]

Age was assessed as age in months at examination. Survey participants aged 8 years and over were eligible for whole-body DXA scans. Race and Hispanic origin were reported separately by participants or proxy respondents (such as parents) and categorized on the publicly-released NHANES data files as Hispanic, non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, and non-Hispanic other race (including non-Hispanic persons who reported two or more races).[24] Non-Hispanic persons reporting another race or multiple races were included in the overall analysis by sex and age, but results for this group were not reported separately. Non-Hispanic Black, non-Hispanic Asian, and Hispanic persons were oversampled during 2011–2018 survey cycles to improve the stability and reliability of estimates for these subgroups.

Standardized measures of weight and height were obtained during the NHANES examination. BMI was calculated as weight in kilograms divided by height in meters squared and rounded to one decimal place. BMI was categorized based on sex- and age-specific percentiles of the 2000 CDC growth charts as underweight/healthy weight (<85th percentile); overweight (≥85th percentile to <95th percentile); or obesity (≥95th percentile).[25] Underweight and healthy weight youth were grouped due to the small number of participants with underweight (<5th percentile; n=234). A sensitivity analysis that excluded underweight youth was conducted to assess the possibility that comparisons were affected by different proportions of underweight youth within race and Hispanic origin groups. The estimates and overall conclusions were similar to the main analysis, so only results from the overall sample are presented.

Whole-body DXA scans were acquired on Hologic Discovery A densitometers (Hologic, Inc., Bedford, Massachusetts). All scans from 2011–2018 were analyzed with Hologic APEX version 4.0 software with NHANES Body Composition Analysis option. Quality control and data review procedures have been published previously.[26] The weight limit for the DXA examination table was 450 pounds (204.1 kilograms).[26] Percentage body fat (%BF) was calculated as total body fat mass divided by total mass (lean mass plus fat mass) and multiplied by 100. FMI was calculated as total body fat mass in kilograms divided by height (in meters)-squared.

Mean BMI, FMI and %BF are reported. Age-specific means are graphically displayed. Sex-specific means are reported graphically, accompanied by differences by race and Hispanic origin using pairwise t-tests. To account for possible differences in age distributions between race and Hispanic origin groups, overall age-adjusted estimates are presented. Means were adjusted by direct age standardization to the sex-specific age distribution of the overall analytic sample in six-month age groupings. In addition, sex-specific linear regression models for %BF and FMI were used to investigate how race and Hispanic origin differences in BMI relate to race and Hispanic origin differences in %BF and FMI. Interaction terms created with BMI category and race and Hispanic origin were included to test whether the association between race and Hispanic origin and %BF or FMI varied by BMI category, and Satterthwaite-adjusted F statistic p values were reported. Predicted marginal means of %BF and FMI are presented, adjusting for age, BMI category, and BMI category interaction with race and Hispanic origin. All analyses were stratified by sex due to known differences in body composition and pubertal developmental patterns.[27-29]

To further investigate differences in %BF, FMI and BMI by race and Hispanic origin across their range in the population, age adjusted, sex- and race and Hispanic origin-specific distributions of BMI, FMI, and %BF were calculated by kernel density estimation with the oversmoothing method.[30]

NHANES examination sample weights were used to account for differential probabilities of selection, nonresponse, and noncoverage.[24] Taylor series linearization was used to estimate standard errors accounting for the complex survey design features. Differences between groups were tested using a univariate t statistic, and all differences noted were statistically significant at the alpha level of 0.05 or below. No adjustments were applied for multiple comparisons. Analyses were conducted in SAS (version 9.4) and SUDAAN (version 11).

During 2011-2018, 87 examined youth aged 8–19 years were missing height, weight, or both, and were excluded from the analysis (Supplementary Figure 1). An additional 1279 youth did not have a DXA whole body scan completed or the scan was insufficient to calculate body fat percentage and were excluded, leaving a total sample size of 6923 (unweighted percent excluded 1366/8289 = 16.5%). Incomplete scans may be secondary to invalid scans, due to the presence of removable or nonremovable objects, noise, arm/leg overlap, body parts of the scan region, positioning issues, motion, missing limbs, other artifacts or secondary to nonparticipation, due to insufficient time, participant refusal, or medical concerns.[26, 31] Sex-specific distributions by age group (8–11, 12–15, and 16–19 years), race and Hispanic origin, and BMI category among youth with a valid DXA %BF measurement were similar to the distributions among all examined youth.

Results

Unweighted sample sizes and weighted share of the population aged 8-19 years are shown in Table 1 by age group, BMI category, and race and Hispanic origin. Nearly 20% (19.8%) of the entire population had obesity.

Figure 1 shows mean %BF (panel a), FMI (panel b), and BMI (panel c) by sex and age in six-month increments. Mean %BF was higher in females than males across the age range, with the gap increasing around age 12 years. Mean FMI was also higher in females than males, with a larger gap after about age 14 years. Mean %BF appeared relatively flat across adolescence among females but showed a decreasing pattern among males starting around age 12 years. Mean FMI showed an increasing pattern with age among females but was relatively flat among males. Mean BMI increased with age for both sexes, and mean age-specific BMI was similar between males and females.

Age-adjusted mean %BF, FMI, and BMI by sex and race and Hispanic origin are shown in Figure 2. Among males (panel a), %BF was significantly lower among non-Hispanic Black males (23.9% [95% CI, 23.3 to 24.5]) and higher among Hispanic males (28.2% [95% CI, 27.6 to 28.7]) than among other race and Hispanic origin groups. FMI was also higher among Hispanic males (6.8 kg/m^2 [95% CI, 6.6 to 7.1]) compared with all other race and Hispanic origin groups (5.8–5.9 kg/m^2). In contrast, mean BMI was higher among non-Hispanic Black (22.6 kg/m^2 [95% CI, 22.1 to 23.1]) and Hispanic (23.1 kg/m^2 [95% CI, 22.7 to 23.5]) males compared with non-Hispanic White (21.6 kg/m^2 [95% CI, 21.2 to 22.0]) and non-Hispanic Asian (21.0 kg/m^2 [95% CI, 20.5 to 21.6]) males. Mean %BF, FMI, and BMI were not statistically different between non-Hispanic White and non-Hispanic Asian males.

Among females (panel b), mean %BF was significantly higher among Hispanic females (35.7% [95% CI, 35.3 to 36.1]) than among other race and Hispanic origin groups (32.7% – 33.2%), but there were no other significant differences in %BF between race and Hispanic origin groups. FMI was higher among Hispanic females (8.6 kg/m^2 [95% CI, 8.4 to 8.9]) than among non-Hispanic White (7.7 kg/m^2 [95% CI, 7.4 to 8.1]) and non-Hispanic Asian (6.8 kg/m^2 [95% CI, 6.6 to 7.1]) females and lower among Non-Hispanic Asian females compared to other race and Hispanic origin groups. A similar pattern was observed for BMI, although mean BMI was higher among both Hispanic (23.3 kg/m^2 [95% CI, 22.9 to 23.6]) and non-Hispanic Black females (23.9 kg/m^2 [95% CI, 23.3 to 24.5]) compared with non-Hispanic White (22.2 kg/m^2 [95% CI, 21.8 to 22.7]) and non-Hispanic Asian (20.4 kg/m^2 [95% CI, 20.0 to 20.8]) females. Overall patterns by race and Hispanic origin for %BF, FMI and BMI differed from each other.

Figure 3 presents smoothed distributions of BMI, FMI, and %BF by sex and race and Hispanic origin for all youth in the study. These figures allow visual comparison of the different patterns in the distributions across race and Hispanic origin groups; statistical tests were not performed. Among both males and females, the distributions of BMI, FMI, and %BF for Hispanic youth appeared shifted rightward and more skewed, compared with other race and Hispanic origin groups of the same sex. Although the BMI distribution among non-Hispanic Black males appeared shifted rightward compared with non-Hispanic White and non-Hispanic Asian males, the distributions of FMI and particularly %BF among non-Hispanic Black males was shifted to the left compared with the other two groups. Distributions of BMI and %BF appeared similar between non-Hispanic White and non-Hispanic Asian males, although compared with non-Hispanic White males, the BMI distribution for non-Hispanic Asian males was slightly to the left and the %BF distribution was slightly to the right.

Among females, the distributions of BMI and FMI among non-Hispanic Asian females had a higher peak and appeared to be shifted leftward compared with other groups, but the distribution of %BF among non-Hispanic Asian females was shifted rightward and seemed more skewed compared with non-Hispanic Black and non-Hispanic White females. Although the distribution of BMI among non-Hispanic Black females appeared to be shifted rightward and more skewed compared with non-Hispanic White females, the peak of the %BF distribution occurred at a lower %BF among non-Hispanic Black females compared with other race and Hispanic origin groups.

In sex-stratified regression models adjusting for age, race and Hispanic origin, and BMI category, interaction terms between race-Hispanic origin and BMI category were statistically significant, suggesting that the differences in %BF and FMI between race-Hispanic origin groups varied by BMI category (Table 2). Within each BMI category, predicted mean (i.e. estimated marginal mean adjusting for age, BMI category, and BMI category interaction with race and Hispanic origin) %BF was lower among non-Hispanic Black males compared with non-Hispanic White males in the same BMI category, and predicted FMI was lower among non-Hispanic Black males in the underweight/healthy weight and overweight BMI categories. Both %BF and FMI were lower among non-Hispanic Black females compared with non-Hispanic White females in the underweight/healthy weight and overweight BMI categories, but not among females with obesity.

Among youth with underweight/healthy weight, predicted %BF was 1.3 percentage points (95% CI, 0.5 to 2.0 percentage points) higher among non-Hispanic Asian males and 1.4 percentage points (95% CI, 0.6 to 2.2 percentage points) higher among non-Hispanic Asian females, compared with non-Hispanic White youth, while predicted FMI was not significantly different between non-Hispanic White and Asian male or female youth. Among females with obesity, however, predicted %BF was 2.3 percentage points lower (95% CI, −3.9 to −0.6) and predicted FMI was 1.7 kg/m^2 lower (95% CI, −2.7 to −0.7) among non-Hispanic Asian females compared with non-Hispanic White females.

Predicted mean %BF and FMI were significantly higher in Hispanic males with underweight/healthy weight and in Hispanic females with underweight/healthy weight or overweight, compared with non-Hispanic White youth of the same sex and BMI category.

Discussion

Race and Hispanic origin differences in %BF and FMI varied by BMI category in U.S. youth in 2011–2018. Among youth in the underweight/healthy weight category, %BF and FMI were lower among non-Hispanic Black males and females than non-Hispanic White males and females. Conversely, %BF was higher among non-Hispanic Asian and Hispanic males and females with underweight/healthy weight. There were fewer significant race and Hispanic origin differences among youth with obesity. Percentage body fat was lower among non-Hispanic Black males and non-Hispanic Asian females than their non-Hispanic White counterparts with obesity. Differences in BMI by race and Hispanic origin did not mirror differences in %BF and FMI, suggesting that BMI does not adequately capture all race and Hispanic origin differences in adiposity among children and adolescents.

Differences in body fat by race and Hispanic origin among children have been described in many studies.[1, 2, 4, 5] This study builds upon a prior analysis by Flegal et al (2010), using NHANES 1999–2004 data, which found that differences in obesity based on BMI did not reflect similar differences in directly measured body fat, such that most non-Hispanic Black children in the overweight category did not have high adiposity.[1] The patterns of differences in age-standardized mean %BF and BMI between non-Hispanic White and non-Hispanic Black youth in the current study are similar to those observed by Flegal et al. Contrary to the prior study, non-Hispanic Asian persons were able to be analyzed separately in this study. In a prior non-nationally representative study, Freedman et al (2008) also examined differences in mean %BF by race stratified by BMI category using data from 1,104 healthy 5–18 year olds.[5] They found that mean %BF varied by race/ethnicity among boys and girls in lower BMI categories, but there were no statistically significant differences by race/ethnicity among boys and girls with obesity (BMI ≥ 95th percentile) or girls with BMI-for-age between the 85th and 94th percentiles. However, there were fewer children with BMI ≥ 95th percentile than in the other BMI categories, which could have affected the ability to detect significant differences. Using stratified analyses, their study suggested that mean body fat was higher among Asian boys than among White boys within the 50th to 95th percentile of BMI-for-age, was higher among Asian girls compared to White girls within <85th percentile of BMI-for-age, and was lower among Asian girls compared to White girls within the ≥95th percentile of BMI-for-age.[5] We found similar differences in percent body fat by BMI category among Asian youth. However, such differences in percent body fat did not extend to FMI, except among Asian girls ≥95th percentile of BMI-for-age.

Limitations of BMI as an indicator of adiposity have been well-characterized.[4, 32] BMI is a measure of weight relative to height and cannot distinguish between fat mass and fat-free mass.[32] Differences in BMI between race and Hispanic origin groups can thus be due to variations in both lean mass and fat mass.[1] We show here differences in direct measures of adiposity by race and Hispanic origin in the context of BMI. Differences in adiposity among adults with normal weight may be associated with disease risk, though less is known for children and adolescents.[33] For adults, given such limitations and evidence that disease risk among Asian adults is elevated at a lower BMI compared with non-Hispanic White adults, a WHO expert consultation advised that lower BMI cutpoints be used for populations of Asian adults.[34]

This analysis has some strengths. BMI, %BF and FMI were based on direct measurements of weight, height, and body fat. BMI cannot distinguish between lean and fat mass. However, FMI, a direct absolute measure of fat mass, and percent body fat, a direct relative measure of body fat, are useful when used together for distinguishing differences due to lean and fat mass.[20] In addition, the NHANES sample is nationally representative of the civilian non-institutionalized population. Finally, because NHANES over-sampled the entire Hispanic population (instead of only the Mexican American population as in early cycles of NHANES) beginning in 2007 and the non-Hispanic Asian population beginning in 2011, this analysis was able to expand on previous comparisons that used earlier national data by including non-Hispanic Asian and all Hispanic youths. There are at least several limitations. First, despite oversampling, estimates are based on a relatively small sample of non-Hispanic Asian youth. Second, response rates for NHANES have been declining over time, along with those of other national surveys, and lower response rates increase the potential for bias. However, an extensive non-response bias investigation into the 2017–2018 NHANES showed that errors in representation from sample variation and nonresponse were minimized with weighting adjustments.[35] Third, DXA-measured %BF or measured height or weight was missing for 16.3% of examined youth aged 8–19 in 2011–2018, although sociodemographic variables were not different among those with missing data. Fourth, although the regression model adjusted for BMI category, there may be residual confounding by BMI if there are racial-ethnic differences in the distribution of BMI within BMI categories. Additionally, there may be further differences by subgroup within the race and Hispanic origin categories used for this analysis; for example, the prevalence of overweight and obesity among non-Hispanic Asian youth varies by Asian ethnicity,[36] and relationships between BMI, FMI, and %BF may vary by origin or ancestry subgroups within the race and Hispanic origin groups analyzed here.[2]

In this nationally representative sample of U.S. youth that included analysis of non-Hispanic Asian persons and direct measures of body fat, weight and height, differences in %BF and FMI between race and Hispanic origin groups varied by BMI category, providing further evidence that other measures besides BMI are important to consider when studying adiposity among children and adolescents.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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The authors' responsibilities were as follows — NS: prepared the data; CBM: analyzed the data, wrote the paper, and has primary responsibility for the final content; and all authors: designed the research, provided critical revision of the manuscript, and read and approved the final manuscript.

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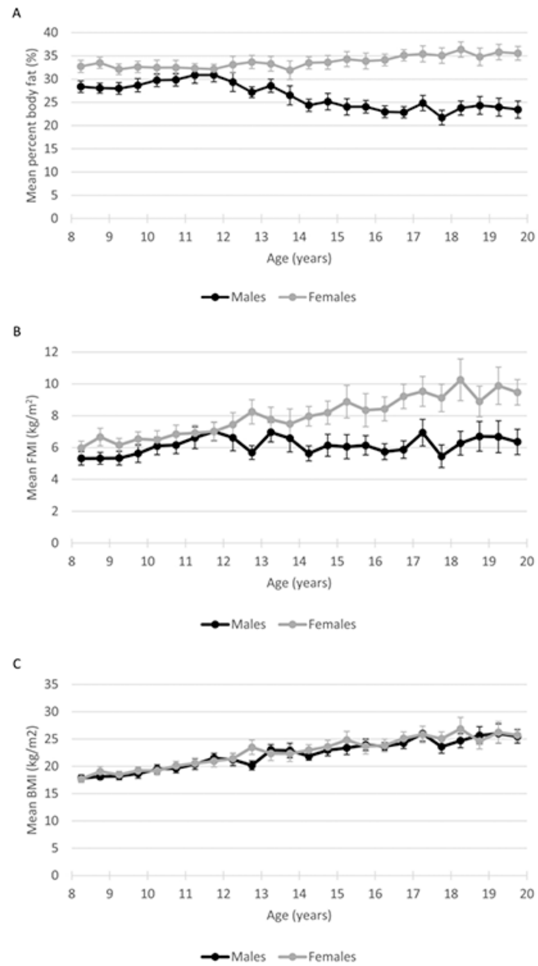

Figure 1.

Mean percentage body fat, Fat Mass Index (FMI), and Body Mass Index (BMI) among children and adolescents aged 8-19 years, by 6-month age intervals and sex: United States, 2011–2018(A) Mean body fat percentage (%BF)(B) Mean fat mass index (FMI). (C) Mean body mass index (BMI) 95% confidence intervals are provided. SOURCE: NCHS, National Health and Nutrition Examination Survey, 2011–2018

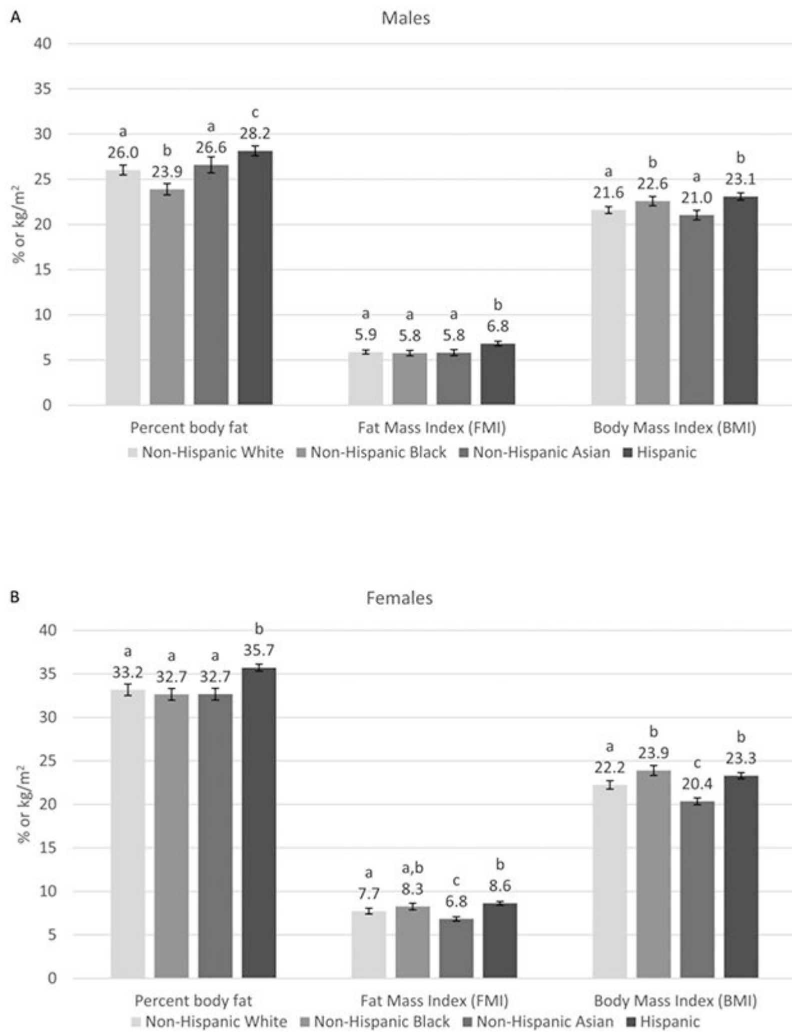

Figure 2.

Age-adjusted mean percentage body fat, FMI, and BMI among children and adolescents aged 8–19 years, by sex and race and Hispanic origin, 2011-2018(A) Males (B) Females Means are weighted and age-adjusted to the sex-specific age distribution of the sample in six-month age groups. 95% confidence intervals are provided. Means with no letter in common are significantly different (t-test; $p < 0.05$)SOURCE: NCHS, National Health and Nutrition Examination Survey, 2011–2018

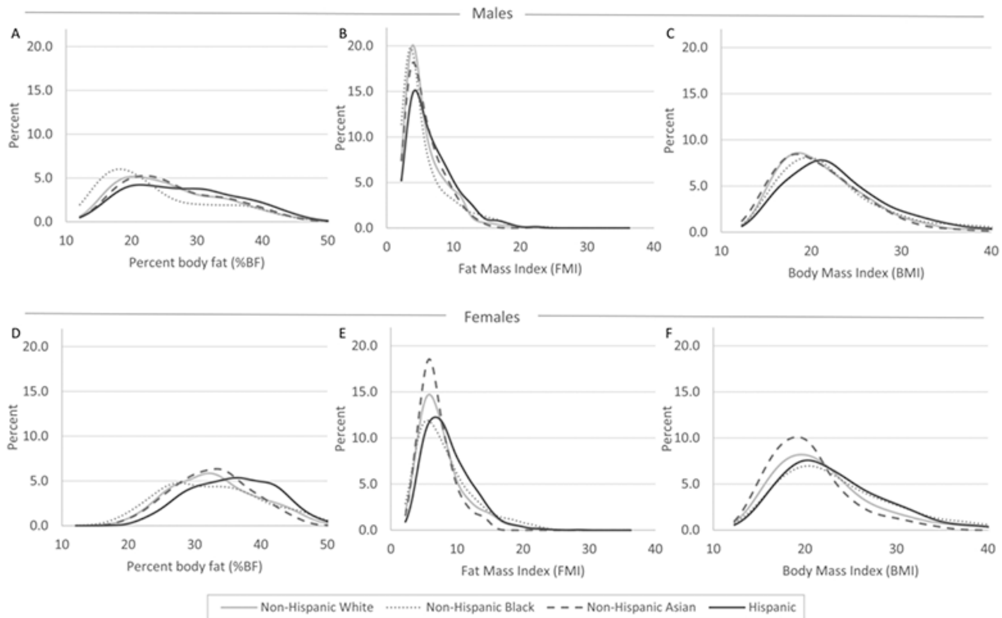

Figure 3.

Distributions of Body Mass Index, Fat Mass Index, and Percentage Body Fat among children and adolescents age 8 - 19 years, by sex and race and Hispanic origin: 2011-2018%"(A) Percent body fat among males (B) Fat Mass Index among males (C) Body Mass Index among males (D) Percent body fat among females (E) Fat Mass Index among females (F) Body Mass Index among females%"Distributions are weighted and age-adjusted to the sex-specific age distribution of the sample in six-month age groups.%"SOURCE: NCHS, National Health and Nutrition Examination Survey, 2011–2018

Table 1.

Unweighted sample sizes and weighted percentage of total among children and adolescents aged 8-19 years, by sex, age group, race and Hispanic origin, and BMI category

	Males		Females		Total	
	Sample size[1]	Percent[2]	Sample size[1]	Percent[2]	Sample size[1]	Percent[2]
All	3584	100	3339	100	6923	100
Age group						
8-11 years	1387	32.7	1347	34	2734	33.3
12-15 years	1164	35.1	998	33.5	2162	34.3
16-19 years	1033	32.3	994	32.5	2027	32.4
Race and Hispanic origin[3]						
Non-Hispanic White	987	52.9	880	54.3	1867	53.6
Non-Hispanic Black	897	13.7	788	12.8	1685	13.2
Non-Hispanic Asian	367	4.4	335	4.6	702	4.5
Hispanic	1090	23.7	1110	23.1	2200	23.4
Body Mass Index (BMI) Category						
Underweight/healthy weight	2223	63.7	2049	63.1	4272	63.4
Overweight	582	16	603	17.5	1185	16.8
Obesity	779	20.3	687	19.3	1466	19.8

[1] Sample sizes are unweighted counts of examined youth aged 8-19 years at exam, with valid measured BMI and body fat percentage.

[2] Weighted percent of the total

[3] Non-Hispanic youth reporting other races or multiple races are included in the totals but not reported separately.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2011–2018.

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Table 2.

Mean percentage body fat and fat mass index predicted by sex-specific, adjusted linear regression model among children and adolescents aged 8-19 years, by sex, race and Hispanic origin, and BMI category: United States, 2011-2018

	Percent body fat (%BF)			Fat Mass Index (FMI)		
Sex, BMI Category and Race-Hispanic Origin[1]	**Predicted Mean (95% CI)[2]**	**Difference in predicted mean (95% CI)[3]**	**P value[4]**	**Predicted Mean (95% CI)[2]**	**Difference in predicted mean (95% CI)[3]**	**P value[4]**
Males						
Underweight/Healthy weight						
Non-Hispanic White	22.2 (21.8 - 22.5)	Ref.	--	4.2 (4.1 - 4.3)	Ref.	--
Non-Hispanic Black	19.4 (18.9 - 19.8)	−2.8 (−3.4 - −2.1)	0	3.7 (3.6 - 3.8)	−0.5 (−0.7 - −0.3)	0
Non-Hispanic Asian	23.4 (22.7 - 24.1)	1.3 (0.5 - 2.0)	0.0011	4.4 (4.2 - 4.6)	0.2 (−0.0 - 0.4)	0.067
Hispanic	23.1 (22.6 - 23.6)	0.9 (0.3 - 1.5)	0.0043	4.5 (4.3 - 4.6)	0.2 (0.1 - 0.4)	0.0064
Overweight						
Non-Hispanic White	30.9 (30.1 - 31.8)	Ref.	--	7.4 (7.2 - 7.7)	Ref.	--
Non-Hispanic Black	26.5 (25.4 - 27.7)	−4.4 (−5.8 - −3.0)	0	6.3 (6.0 - 6.6)	−1.1 (−1.5 - −0.8)	0
Non-Hispanic Asian	31.9 (30.6 - 33.2)	1.0 (−0.7 - 2.7)	0.2585	7.6 (7.3 - 7.9)	0.2 (−0.3 - 0.6)	0.4263
Hispanic	30.3 (29.7 - 31.0)	−0.6 (−1.6 - 0.4)	0.2163	7.3 (7.1 - 7.4)	−0.2 (−0.4 - 0.1)	0.1758
Obesity						
Non-Hispanic White	36.7 (35.9 - 37.5)	Ref.	--	11.0 (10.6 - 11.4)	Ref.	--
Non-Hispanic Black	35.6 (34.8 - 36.3)	−1.1 (−2.2 - −0.0)	0.0449	11.5 (11.1 - 12.0)	0.5 (−0.1 - 1.1)	0.0871
Non-Hispanic Asian	36.7 (35.2 - 38.2)	0.1 (−1.6 - 1.7)	0.9454	10.7 (9.9 - 11.5)	−0.3 (−1.2 - 0.6)	0.4982
Hispanic	37.3 (36.6 - 38.0)	0.6 (−0.4 - 1.6)	0.2325	11.5 (11.1 - 11.9)	0.5 (−0.0 - 1.0)	0.0605
Females						
Underweight/Healthy weight						
Non-Hispanic White	29.7 (29.2 - 30.2)	Ref.	--	5.8 (5.7 - 6.0)	Ref.	--
Non-Hispanic Black	27.7 (27.1 - 28.2)	−2.0 (−2.7 - −1.4)	0	5.5 (5.3 - 5.6)	−0.3 (−0.5 - −0.2)	0.0007
Non-Hispanic Asian	31.1 (30.5 - 31.8)	1.4 (0.6 - 2.2)	0.001	6.0 (5.8 - 6.1)	0.2 (−0.1 - 0.4)	0.1659
Hispanic	31.7 (31.3 - 32.2)	2.0 (1.4 - 2.7)	0	6.3 (6.2 - 6.4)	0.5 (0.3 - 0.7)	0
Overweight						
Non-Hispanic White	37.2 (36.5 - 37.9)	Ref.	--	9.2 (9.0 - 9.5)	Ref.	--
Non-Hispanic Black	34.6 (34.0 - 35.2)	−2.5 (−3.4 - −1.6)	0	8.7 (8.5 - 8.9)	−0.5 (−0.8 - −0.2)	0.0007
Non-Hispanic Asian	38.3 (37.1 - 39.6)	1.2 (−0.3 - 2.6)	0.1185	9.5 (9.1 - 9.9)	0.3 (−0.2 - 0.8)	0.2639
Hispanic	38.5 (37.9 - 39.1)	1.3 (0.4 - 2.2)	0.0051	9.6 (9.4 - 9.7)	0.3 (0.0 - 0.6)	0.0322
Obesity						
Non-Hispanic White	42.8 (42.0 - 43.6)	Ref.	--	13.7 (13.2 - 14.3)	Ref.	--
Non-Hispanic Black	41.9 (41.0 - 42.8)	−0.8 (−2.0 - 0.3)	0.1608	14.0 (13.3 - 14.7)	0.3 (−0.7 - 1.2)	0.5531
Non-Hispanic Asian	40.5 (39.1 - 41.8)	−2.3 (−3.9 - −0.6)	0.0072	12.0 (11.3 - 12.8)	−1.7 (−2.7 - −0.7)	0.0017
Hispanic	42.5 (42.1 - 42.9)	−0.3 (−1.2 - 0.6)	0.5167	13.3 (12.9 - 13.6)	−0.5 (−1.1 - 0.2)	0.1384

[1]Interaction term between BMI category and race-Hispanic origin was statistically significant ($p<0.05$) in sex-specific linear regression model adjusting for age, BMI category, and BMI category interacted with race and Hispanic origin

[2]Predicted marginal from sex-specific linear regression model adjusting for age, BMI category, and BMI category interacted with race and Hispanic origin

[3]Difference in predicted mean compared to reference group calculated as linear contrasts of predicted marginals, adjusting for age, BMI category and BMI category interacted with race and Hispanic origin

[4]P-value for difference in predicted mean compared to reference group, adjusting for age, BMI category and BMI category interacted with race and Hispanic origin

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2011–2018.