RESPONSE TO THE COMMENTS FROM THE COMMITTEE AND REVIEWERS

The Committee

Comment #1: For non-US readers, can you please explain the racial and ethnic categories that are used? One non-US editor wondered "Why are all the ethnic groups described in relation to Hispanic? Is there a need to say Non-Hispanic Asian or Non-Hispanic Black? Why not just Asian or Black? Even saying Asian encompasses everything from Middle Eastern to Southeast Asian..."

Response: We thank the committee for the comment. In our manuscript, race/ethnicity was classified following the federal regulations specified in the 1997 US Office of Management and Budget (OMB) Standards for the Classification of Federal Data on Race and Ethnicity (https://obamawhitehouse.archives.gov/omb/fedreg_1997standards). In the Standards, ethnicity refers to "Hispanic or Latino" and "Not Hispanic or Latino". Therefore, it has been a routine to define both racial and ethnic categories for federal data (e.g., national health surveys by the CDC) or any other data collected in compliance with the OMB Standards. The categorization we used in this study (Hispanic, non-Hispanic white, non-Hispanic black, non-Hispanic Asian, and other) is consistent with that in numerous CDC reports, previous publications, and analytic guidelines from the NHANES.[1-4]

Comment #2: We thought you have some potentially interesting descriptive data examining changes in body composition (e.g., discrepancy between weight and either lean or fat mass) according to race/ethnicity/sex. At the same weight, one can look more like an Olympic swimmer or the Pillsbury doughboy, with obvious health implications.

It's important to recognize that this study involves sequential cross-sectional surveys, so time trends assume that confounding can be eliminated. NHANES is designed to be nationally-representative, so you should be on solid ground. However, the small number of individuals in the numerous cells in some analyses gives us concern.

Table 3 shows body fat (the key novelty of the paper) among 10,000 participants cumulatively among 4 surveys, 5 race-ethnic groups and 2 sexes. Thus, the average cell has just 250

individuals. How confident can we be that confounding or other bias wouldn't creep into these analyses? Could you please comment?

Response: We thank the committee for the thoughtful comment. In this study, sampling weights created by the National Center for Health Statistics (NCHS) were applied in all analyses according to the NHANES analytic guidelines. A sampling weight is assigned to each sample person. Sampling weights can be considered as measures of the number of persons represented by the particular sample person.

In NHANES, the sampling weights have accounted for the differential probabilities of selection for the individual domains, nonresponse to survey instruments, and differences between the final sample and the total population.[4][5]

In addition, the NCHS has often used thresholds based on the relative standard error (RSE) in determining whether to show an estimate or whether to identify an estimate as unreliable in its reports (https://wwwn.cdc.gov/nchs/nhanes/tutorials/module5.aspx).[4] RSE is defined as the standard error of the estimated statistic divided by the estimated statistic, and is usually expressed as a percentage (formula shown below). According to the NCHS, %RSE greater than or equal to 30% should be identified as unreliable.

%RSE = (Standard error of estimate / Estimate) * 100

In the current study, the %RSE in each cell ranged from 0.11% to 5.5% for Table 3, which is much lower than 30% (shown below, Table R1), suggesting that the estimates are reliable.

Table R1. The Relative Standard Error (RSE) for Estimate of Age-Adjusted Body Fat Percentage by Race/Ethnicity: United State, 2011-2018 (N=10,864)[a]

Variables	2011-2012		2013-2014		2015-2016		2017-2018	
	Estimate (SE)	%RSE	Estimate (SE)	%RSE	Estimate (SE)	%RSE	Estimate (SE)	%RSE
Overall	32.6 (0.30)	0.92	33.1 (0.27)	0.82	32.9 (0.29)	0.88	33.0 (0.29)	0.88
All participants								
Hispanic	33.7 (0.42)	1.25	33.8 (0.45)	1.33	34.0 (0.38)	1.12	34.1 (0.38)	1.11
Non-Hispanic white	32.5 (0.33)	1.02	33.1 (0.37)	1.12	32.8 (0.36)	1.10	32.9 (0.37)	0.11
Non-Hispanic black	32.6 (0.31)	0.95	32.5 (0.38)	1.17	31.9 (0.58)	1.82	32.0 (0.65)	2.03
Non-Hispanic Asian	30.6 (0.38)	1.24	31.7 (0.25)	0.79	31.4 (0.28)	0.89	32.7 (0.34)	1.04
Other	31.9 (0.95)	2.98	31.9 (1.03)	3.23	33.1 (1.33)	4.02	33.9 (0.92)	2.71
Male								
Hispanic	27.8 (0.33)	1.19	28.0 (0.45)	1.61	28.4 (0.38)	1.34	28.6 (0.49)	1.71
Non-Hispanic white	27.1 (0.28)	1.03	27.9 (0.44)	1.58	26.8 (0.35)	1.31	27.2 (0.35)	4.96
Non-Hispanic black	25.0 (0.24)	0.96	25.0 (0.37)	1.48	24.9 (0.54)	2.17	25.5 (0.53)	2.08
Non-Hispanic Asian	25.5 (0.40)	1.57	26.7 (0.37)	1.39	26.8 (0.28)	1.04	28.2 (0.25)	0.89
Other	28.1 (1.13)	4.02	26.4 (1.05)	3.98	27.1 (1.49)	5.50	28.3 (1.04)	3.67
Female								
Hispanic	40.3 (0.37)	0.92	40.0 (0.32)	0.8	40.2 (0.31)	0.77	40.0 (0.35)	0.88
Non-Hispanic white	38.3 (0.32)	0.84	38.5 (0.26)	0.68	38.3 (0.44)	1.15	38.0 (0.67)	1.76
Non-Hispanic black	39.7 (0.43)	1.08	39.7 (0.31)	0.78	38.9 (0.27)	0.69	39.2 (0.65)	1.66
Non-Hispanic Asian	36.2 (0.58)	1.60	36.5 (0.25)	0.68	36.4 (0.56)	1.54	37.1 (0.63)	1.70
Other	36.4 (1.03)	2.83	38.2 (0.81)	2.12	38.4 (1.00)	2.60	39.9 (0.88)	2.21

[a] percent body fat was available among adults aged 20-59 years.

Comment #3: Also, a couple potentially relevant studies that you might consider citing:

1. Nutr Res. 2020 Jul 12;81:58-70. Fat-free mass characteristics vary based on sex, race, and weight status in US adults. Tinsley GM(1), Smith-Ryan AE(2), Kim Y(3), Blue MNM(2), Nickerson BS(4), Stratton MT(5), Harty PS(5).

Common body composition estimation techniques necessitate assumptions of uniform fat-free mass (FFM) characteristics, although variation due to sex, race, and body characteristics may occur. National Health and Nutrition Examination Survey
data from 1999 to 2004, during which paired dual-energy x-ray absorptiometry (DXA) and bioimpedance spectroscopy assessments were performed, were used to estimate FFM characteristics in a sample of 4619 US adults. Calculated FFM characteristics included the density and water, bone mineral, and residual content of FFM. A rapid 4-component model was also produced using DXA and
bioimpedance spectroscopy data. Study variables were compared across sex, race/ethnicity, body mass index (BMI), and age categories using multiple pairwise comparisons. A general linear model was used to estimate body composition after controlling for other variables. Statistical analyses accounted for 6-year sampling weights and complex sampling design of the National Health and Nutrition Examination Survey and were based on 5 multiply imputed datasets. Differences in FFM characteristics across sex, race, and BMI were observed, with notable dissimilarities between men and women for all outcome variables. In racial/ethnic comparisons, non-Hispanic blacks most commonly presented distinct FFM characteristics relative to other groups, including greater FFM density and proportion of bone mineral. Body composition errors between DXA and the 4-component model were significantly influenced by sex, age, race, and BMI. In conclusion, FFM characteristics, which are often assumed in body composition estimation methods, vary due to sex, race/ethnicity, and weight status. The variation of FFM characteristics in diverse populations should be considered when body composition is evaluated.

BMC Public Health. 2017 Aug 25;17(1):678. Prevalence and change of central obesity among US Asian adults: NHANES 2011-2014. Liu X(1)(2)(3), Chen Y(4), Boucher NL(5), Rothberg

AE(6)(7).

BACKGROUND: Central obesity is a major risk factor for cardiometabolic diseases. The prevalence of central obesity has not been reported fully among Asian adults in the United States (US).

METHODS: Cross-sectional data of 1288 Asian adults aged 20 years or over was selected from the US National Health and Nutrition Examination Survey with a stratified multi-stage sampling design. The prevalence of central obesity was calculated with 95% confidence intervals (CIs) and Chi-square tests were conducted to test the significance of the prevalence differences across characteristic groups.

RESULTS: The overall prevalence of central obesity among US Asian adults was 58.1% in 2011-2014. The prevalence of central obesity was higher in older adults (73.5%) than in young adults (45.4%) (p < 0.0001). Women had 13.4% higher prevalence than men (64.4% vs 51.0%, p < 0.0001). The prevalence increased over time (2011-2012 vs 2013-2014) in young adults (39.2% vs 51.5%), men (45.4% vs 56.6%), adults with college education or above (54.2% vs 61.7%) and non-poor adults (55.4% vs 62.4%). Compared with men, women had higher prevalence in each subgroup of age, education, poverty, and length of time (except for the subgroup of "born in the US") (all p < 0.05) and in the subgroup of "married or living with partner" for marital status (p < 0.0001).

CONCLUSION: Central obesity is prevalent in Asian adults, particularly in older adults and women. More efforts are needed to prevent and treat obesity in Asian adults as Asians are incurring the greatest increase in type 2 diabetes in parallel with the rising rate of central adiposity.

Response: We thank the committee for the comment. We have cited these studies as suggested.

Comment #4: We think that a paper describing trends and descriptive data might benefit from some graphs and other visual displays of data. The tables have useful numbers but are tedious to read for trends. Is there some way to better visualise the data?

Response: We thank the committee for the comment. We have added a figure to show the trend in BMI, waist circumference, body fat percentage, lean mass by race/ethnicity (Figure 1).

Comment #5: We thought this was especially interesting in view of the mortality statistics for covid, where obesity and race/ethnicity appear to play a role in susceptibility to poor outcomes.

Response: We thank the committee for the thoughtful comment. It is a good idea that worth exploring.

Comment #6: In your response, please provide, point by point, your replies to the comments made by the reviewers and the editors, explaining how and where you have dealt with them in the paper.

Please pay special attention to the review from Professor Morris, our statistical consultant. Her recommendations should take precedence in the case of conflicting suggestions.

Response: We thank the committee for the reminder. We have provided a point by point response.

Comments from Reviewers

Reviewer: 1

Comments:

Liu and colleagues conducted an impressive study on 21,399 patients using NHANES data from the National Health and Nutrition Examination Survey from 2011 until 2018. They found that trends in obesity and adiposity differed by race. In Hispanics and non-Hispanic whites and Asians, age-adjusted BMI and waist circumferences rose from 2011 until 2018. However, in non-Hispanic blacks, the age-adjusted mean lean mass significantly decreased and other measures of adiposity remained constant.

The analysis was comprehensive and well done. A few questions:

Comment #1. Does the data provide information about those who are 2 or more races? I.e. half black and half white? It would be interesting to see whether trends are significantly increasing or decreasing in this group of individuals.

Response: We thank the reviewer for the comment. It is true that trends among people with multiple races are very interesting. Unfortunately, we do not seem to have enough sample size to estimate the trends among people who are two or more races.

Comment #2. Please reword last sentence of objective to say "The object is to examine the trends in obesity and adiposity measures, including BMI, waist circumference, body fat percentage, and lean mass, by race/ethnicity among US adults from 2011-2018."

Response: Done (Page 3, Line 5-6).

Comment #3. Last sentence of results in abstract, should it say <0.05 rather than >?

Response: We thank the reviewer for the careful review. We have double-checked the numbers. It should be >0.05. These are the P values for trend for lean mass among Hispanic (P=0.27), non-Hispanic white (P=0.66), and other race/ethnicity (P=0.76).

Comment #4. Can you separate visceral fat and subcutaneous fat?

Response: We thank the reviewer for the thoughtful comment. However, NHANES body composition data does not separate visceral fat and subcutaneous fat.

Reviewer: 2

Comments:

This is a study of multiple adiposity measures in the US populations. This study adds upon previous studies by including new measures and more recent data, this study. These descriptive trends are useful for understanding contemporary obesity trends in the US population.

Major comments

Comment #1. My main comment is regarding the various adjustments made and the rationale for these adjustments. It's unclear why age-adjusted levels are the baseline for this descriptive study, especially given the rate/ethnicity stratifications and different age distributions by racial/ethnic groups, which may then cloud the descriptive findings. I recommend that at a minimum, unadjusted values be included in all tables. Secondly, I would strongly encourage the authors to consider the rationale for their adjusted values. This rationale should be clearly presented in the paper. Please see Kaufman et al. 2017 for detail regarding potential challenges of adjustments in this type of analysis. [Kaufman, J. S. (2017). Statistics, Adjusted Statistics, and Maladjusted Statistics. American Journal of Law & Medicine, 43(2–3), 193–208.] A recent commentary by Conroy and Murray will also be useful to review [2020 British Journal of Cancer https://doi.org/10.1038/s41416-020-1019-z]

Response: We thank the reviewer for the comment. We totally concur with the reviewer that adjustment should be cautious. However, as mentioned in the publication by Kaufman,[6] "age standardization a routine adjustment in nearly all vital statistics reporting", and age, as one of the permissible variables, seems difficult to contest. Meanwhile, considering the objective of the current study, examining the trends in obesity and adiposity measures, we thought it is appropriate to report age-adjusted estimates, which obeyed the NHANES guideline (https://wwwn.cdc.gov/nchs/nhanes/tutorials/module8.aspx) and was consistent with previous CDC reports.[7-9] We have clarified the rationale of reporting age-adjusted estimates in the original manuscript (Page 10, Line 1-7).

However, we agree with the reviewer that it has merits to report the unadjusted numbers to show the natural status without consideration of age. Therefore, we provided unadjusted values as

suggested in the supplemental materials (Appendix Table 3,4,5,8,10), and the results were almost the same as the age-adjusted estimates.

Comment #2. When interpreting changes in trends over time, take care to ensure that the p-values are not interpreted in such a way that it proves absence or lack of trend. Describe alongside the change in effects. [See Wasserstein, & Lazar. (2016) The ASA's statement on p-values: context, process, and purpose. Am. Stat. 70, 129–133.]

Response: We thank the reviewer for the comment. We have removed the word "significant" in the discussion section.

Comment #3. The Discussion would benefit from some mention of social and structural factors in the US underlying these trends.

Response: We thank the reviewer for the comment. We have added some discussion about social and structural factors in the manuscript (Page 17, Line 4-7).

Comment #4. A flow chart clearly describing the creation of the analytic cohort for the various measures would aid in the clarity and reproducibility. This could be placed in the supplement but should be included.

Response: We thank the reviewer for the comment. A flow chart of participants was provided in Appendix Figure 1.

Reviewer: 3

Comments:

The authors present d the trends of adiposity measures in US adults participating in NHANES from 2011 to 2018. Although the subject or methods are not necessarily novel, the topic is important and relevant to the growing concerns of obesity globally. The use of NHANES data offers reproducible methods in measuring adiposity and representativeness of the US population, and the separate category of Non-Hispanic Asians provided a valuable insight into the role of modern population structure in obesity. However, some points need to be clarified for further understanding of the subject and the study findings.

Major

Comment #1. The authors have nicely mentioned the projected proportion of Asian Americans in the Background. Overall, how did the proportion of the included ethnicities change over the years in the US during the periods when these surveys were conducted?

Response: We thank the reviewer for the comment. Asian Americans are the fastest growing subpopulation in the United States. According to the annual estimate data about the national population by characteristics 2010-2019 released from the United States Census Bureau (https://www.census.gov/data/tables/time-series/demo/popest/2010s-national-detail.html),[10] we created the below table to show the proportion of each race/ethnicity group from 2011-2018 (Table R2). In NAHNES, Asian Americans were oversampled in 2011-2018 in order to allow better estimates of health conditions in this subpopulation. To account for this oversampling and other design-related or survey-related features, we used the NHANES sampling weights created by the National Center for Health Statistics in all the analyses in this study.

Table R2. The National Population by Race/ethnicity: 2011-2018

	2011	2012	2013	2014	2015	2016	2017	2018
Hispanic	16.6%	16.9%	17.1%	17.3%	17.5%	17.8%	18.0%	18.3%
Non-Hispanic white	63.4%	63.0%	62.6%	62.1%	61.7%	61.3%	60.8%	60.5%
Non-Hispanic black	12.3%	12.3%	12.4%	12.4%	12.4%	12.5%	12.5%	12.5%

Non-Hispanic Asian	4.9%	5.0%	5.1%	5.2%	5.4%	5.5%	5.6%	5.7%
Other	2.8%	2.8%	2.9%	2.9%	3.0%	3.0%	3.0%	3.1%

Comment #2. P-trends presented for continuous adiposity measures were from linear regression. How did the model perform? Was there any indication that adiposity trends over the years were non-linear?

Response: We thank the reviewer for the comment. We included the survey year in models as a continuous variable when calculating the P-trends. It is without doubt interesting to explore whether there is any non-linear trend. However, in this study, there are only 4 time points, which restrict our ability to do so. According to the guideline National Center for Health Statistics Guidelines for Analysis of Trends, when there are no sufficient time points, a test for trend can be performed to determine whether the trend is nonlinear or linear.[11] Exploring non-linear trends will be performed in future studies when data of more time points are available.

Comment #3. How was missing data handled?

Response: High completeness of data is a major strength of NHANES because of dedicated in-person interviews and the uniquely-designed mobile exam center. In this study, there are no missing data for age, sex, and race/ethnicity. The rate of missing was 1.4% for BMI and 6.2% for waist circumference, and 22.0% for body fat percentage and lean mass. The missing rate for DXA-measured body fat percentage and lean mass was higher than BMI and waist circumference, but it was not surprising because participants may have concerns about the exposure to low-level X-ray for DXA scan. The reason of missing for DXA data was present in Appendix Figure 1.

When estimating the trends of adiposity measures, participants with missing data on BMI, waist circumference, body fat percentage, and lean mass were not included in corresponding analyses, respectively. However, we used the sampling weights created by the National Center for Health Statistics to account for selection bias, non-response, and other design-related or survey-related features in all the analyses. However, we acknowledged in the limitation that the estimates in this study may not be able to fully represent the status of body composition among participants without DXA data because of refusal or other reasons like medical tests (Page 19, Line 6-9).

Comment #4. A visualisation of growth in adiposity measures over the survey years would be highly informative

Response: We thank the reviewer for the comment. A figure was added as suggested (Figure 1).

Comment #5. Although ethnicity is an important contributing factor towards adiposity, heritability only explains a limited proportion of obesity. Did the authors incorporate socioeconomic status indices such as education or household income in the analysis?

Response: We thank the reviewer for the comment. It is a good idea to include socioeconomic status when examining the risk factors of adiposity. We conducted additional analyses to incorporate education and household income in the analysis (Table R3-8). However, we noticed that the sample size in some cells is very small (only 8). Therefore, we decided not to include these results in the main tables.

Table R3. Trends in Age-Adjusted Mean BMI by Race/Ethnicity: United State, 2011-2018 (N=21,093)

Variables	Age-adjusted BMI, kg/m^2, mean (95%CI)				*P* for trend
	2011-2012	2013-2014	2015-2016	2017-2018	
Education [a]					
Less than high school	29.1 (28.5-29.8)	29.2 (28.8-29.7)	29.6 (28.9-30.2)	29.5 (28.4-30.5)	0.26
High school	29.6 (28.8-30.3)	29.8 (29.1-30.5)	29.9 (29.1-30.8)	30.3 (29.9-30.7)	0.04
College or higher	28.3 (27.9-28.8)	28.9 (28.4-29.4)	29.1 (28.5-29.7)	29.6 (28.9-30.4)	0.002
Less than high school [b]					
Hispanic	30.0 (29.4-30.7)	29.7 (29.3-30.2)	30.4 (29.6-31.2)	29.9 (29.1-30.7)	0.70
Non-Hispanic white	28.1 (27.3-28.9)	28.8 (27.9-29.7)	29.4 (28.0-30.8)	30.0 (26.5-33.4)	0.10
Non-Hispanic black	30.9 (29.5-32.3)	29.7 (28.6-30.8)	29.4 (28.0-30.7)	29.6 (28.2-30.9)	0.06
Non-Hispanic Asian	25.3 (23.7-26.9)	25.3 (23.6-27.0)	24.8 (23.5-26.1)	25.6 (24.5-26.8)	0.71
Other	28.2 (26.4-29.9)	29.6 (25.7-33.5)	29.7 (26.4-33.1)	27.7 (25.0-30.4)	0.58
High school [b]					
Hispanic	30.2 (29.0-31.4)	29.9 (29.1-30.7)	31.1 (30.1-32.0)	31.0 (30.3-31.8)	0.13
Non-Hispanic white	29.3 (28.3-30.3)	29.9 (28.8-31.0)	29.6 (28.6-30.6)	29.9 (29.2-30.6)	0.40
Non-Hispanic black	30.4 (29.4-31.5)	30.9 (29.8-32.1)	30.0 (28.8-31.2)	31.2 (30.0-32.5)	0.31
Non-Hispanic Asian	24.9 (24.0-25.7)	23.9 (23.1-24.8)	25.6 (24.3-26.8)	26.7 (25.9-27.5)	0.001
Other	28.9 (26.5-31.2)	28.3 (26.7-29.9)	32.1 (29.1-35.1)	31.8 (29.8-33.7)	0.045
College or higher [b]					
Hispanic	28.8 (28.1-29.4)	29.9 (28.8-31.0)	30.6 (29.6-31.5)	30.1 (29.5-30.8)	0.01
Non-Hispanic white	28.1 (27.6-28.7)	28.7 (28.3-29.2)	28.9 (28.3-29.5)	29.5 (28.5-30.5)	0.01
Non-Hispanic black	31.0 (30.4-31.7)	31.2 (30.2-32.1)	31.1 (30.2-32.0)	31.6 (31.0-32.3)	0.16
Non-Hispanic Asian	24.4 (24.0-24.9)	24.9 (24.4-25.4)	24.9 (24.5-25.4)	26.2 (25.9-26.5)	<0.0001
Other	29.9 (27.2-32.7)	29.8 (28.1-31.5)	30.3 (28.9-31.7)	30.5 (29.3-31.8)	0.54
Income status [a]					

<1	29.0 (28.4-29.5)	29.5 (28.8-30.3)	30.3 (29.6-31.1)	30.0 (29.0-31.0)	0.02
1-2.9	29.4 (28.8-30.0)	30.2 (29.6-30.8)	29.6 (28.8-30.4)	30.1 (29.4-30.9)	0.19
≥3	28.0 (27.3-28.6)	28.3 (27.8-28.8)	29.0 (28.3-29.7)	29.5 (28.8-30.3)	0.001
Missing	28.5 (27.7-29.3	28.5 (27.4-29.6)	28.6 (27.9-29.3)	29.7 (28.5-30.9)	0.052
IRP<1 [b]					
Hispanic	29.7 (29.0-30.4)	29.8 (28.8-30.7)	31.4 (30.5-32.3)	29.9 (29.0-30.8)	0.06
Non-Hispanic white	28.3 (27.4-29.2)	29.3 (28.3-30.3)	30.2 (28.7-31.7)	30.1 (28.3-31.8)	0.04
Non-Hispanic black	30.7 (29.4-32.0)	30.7 (29.7-31.7)	30.2 (29.1-31.3)	31.2 (30.3-32.1)	0.70
Non-Hispanic Asian	24.4 (23.4-25.4)	24.5 (23.3-25.6)	25.3 (24.3-26.2)	25.4 (23.9-26.9)	0.09
Other	30.3 (27.2-33.5)	29.6 (26.6-32.5)	31.5 (29.1-33.9)	30.5 (27.9-33.0)	0.81
IPR 1-2.9 [b]					
Hispanic	29.9 (29.2-30.5)	30.3 (29.6-30.9)	30.5 (29.6-31.4)	30.9 (30.1-31.6)	0.03
Non-Hispanic white	29.3 (28.3-30.3)	30.1 (29.3-30.9)	29.4 (28.5-30.4)	29.7 (28.5-30.9)	0.60
Non-Hispanic black	30.7 (29.6-31.8)	31.1 (30.2-32.1)	31.0 (29.9-32.2)	31.6 (30.5-32.7)	0.34
Non-Hispanic Asian	24.8 (23.8-25.8)	25.0 (24.2-25.8)	24.4 (23.8-25.0)	26.7 (25.9-27.4)	0.02
Other	31.6 (29.2-34.1)	32.6 (29.2-36.0)	29.8 (27.7-31.9)	31.1 (29.5-32.7)	0.54
IPR ≥3 [b]					
Hispanic	29.2 (28.6-29.8)	29.4 (28.0-30.7)	30.6 (29.0-32.1)	30.0 (28.7-31.2)	0.24
Non-Hispanic white	27.8 (27.1-28.5)	28.4 (27.8-28.9)	29.0 (28.2-29.7)	29.6 (28.7-30.5)	0.001
Non-Hispanic black	31.4 (30.1-32.7)	30.6 (29.7-31.5)	30.5 (29.4-31.5)	31.2 (30.0-32.4)	0.93
Non-Hispanic Asian	24.4 (24.0-24.8)	25.0 (24.3-25.6)	24.9 (24.3-25.4)	25.7 (25.2-26.3)	0.0004
Other	27.4 (26.2-28.6)	26.3 (23.8-28.8)	31.0 (28.9-33.0)	29.7 (27.0-32.3)	0.13

[a] P for trend adjusted for age, sex, and race/ethnicity.
[b] P for trend adjusted for age and sex.

Table R4. Trends in Age-Adjusted Mean Waist Circumference by Race/Ethnicity: United State, 2011-2018 (N=20,080)

Variables	Age-adjusted waist circumference, cm, mean (95%CI)				P for trend
	2011-2012	2013-2014	2015-2016	2017-2018	
Education [a]					
Less than high school	99.8 (98.7-100.8)	99.5 (98.3-100.7)	100.3 (98.6-102.0)	99.7 (97.3-102.1)	0.76
High school	100.7 (99.0-102.5)	100.9 (99.4-102.4)	101.7 (99.7-103.6)	102.0 (100.8-103.3)	0.09
College or higher	97.5 (96.4-98.5)	98.8 (97.7-99.9)	99.5 (97.9-101.0)	100.0 (97.9-102.1)	0.02
Less than high school [b]					
Hispanic	100.0 (98.4-101.6)	100.2 (99.1-101.3)	101.0 (99.1-102.8)	99.8 (97.7-101.8)	0.95
Non-Hispanic white	99.7 (97.7-101.6)	99.9 (97.7-102.0)	102.5 (99.1-105.8)	101.4 (94.4-108.4)	0.40
Non-Hispanic black	101.2 (97.7-104.7)	97.3 (95.0-99.7)	98.3 (95.4-101.3)	99.5 (95.8-103.2)	0.44
Non-Hispanic Asian	90.0 (86.1-93.9)	89.5 (85.7-93.2)	87.4 (84.6-90.2)	89.4 (86.3-92.6)	0.86
Other	98.1 (92.3-103.9)	102.6 (92.3-113.0)	99.2 (92.1-106.2)	98.4 (90.2-106.6)	0.51
High school [b]					
Hispanic	101.1 (98.0-104.2)	99.4 (96.9-102.0)	102.8 (100.9-104.7)	102.8 (100.3-105.3)	0.25
Non-Hispanic white	101.2 (98.9-103.5)	101.9 (99.5-104.4)	101.9 (99.7-104.1)	102.1 (100.2-103.9)	0.44
Non-Hispanic black	100.3 (98.6-102.1)	100.9 (98.3-103.5)	99.9 (97.3-102.5)	100.9 (98.2-103.6)	0.68
Non-Hispanic Asian	86.9 (84.3-89.6)	85.6 (82.8-88.4)	89.4 (86.4-92.5)	91.8 (90.0-93.6)	0.0004
Other	99.8 (92.5-107.1)	101.3 (96.8-105.9)	108.7 (101.2-116.1)	107.2 (100.1-114.2)	0.15
College or higher [b]					
Hispanic	97.4 (95.7-99.0)	100.3 (97.4-103.1)	100.8 (99.0-102.7)	100.5 (98.9-102.0)	0.01
Non-Hispanic white	97.7 (96.5-99.0)	98.9 (97.7-100.1)	99.7 (97.9-101.4)	100.3 (97.6-103.0)	0.049
Non-Hispanic black	100.9 (99.5-102.4)	101.7 (99.7-103.7)	101.5 (98.7-104.2)	101.9 (100.2-103.6)	0.40
Non-Hispanic Asian	87.1 (86.1-88.1)	88.7 (87.5-89.9)	88.7 (87.5-89.9)	90.5 (89.7-91.4)	<0.0001
Other	100.9 (93.8-108.1)	99.4 (94.2-104.6)	102.2 (99.6-104.8)	102.1 (99.1-105.1)	0.45
Income status [a]					

<1	98.8 (97.4-100.2)	99.9 (98.0-101.8)	101.8 (100.2-103.4)	100.8 (98.8-102.8)	0.03
1-2.9	100.0 (98.6-101.4)	101.4 (100.2-102.5)	100.5 (98.4-102.5)	101.4 (99.6-103.2)	0.23
≥3	97.2 (95.6-98.8)	97.9 (96.7-99.1)	99.7 (98.0-101.4)	100.0 (97.9-102.0)	0.01
Missing	98.0 (96.3-99.7)	97.7 (95.4-100.0)	97.6 (95.7-99.4)	99.6 (95.7-103.5)	0.33
IRP<1 [b]					
Hispanic	98.9 (96.9-100.9)	100.3 (97.4-103.2)	102.9 (101.1-104.8)	99.8 (97.3-102.2)	0.14
Non-Hispanic white	99.3 (97.3-101.3)	101.0 (98.1-103.8)	103.1 (99.9-106.2)	102.4 (99.2-105.7)	0.04
Non-Hispanic black	99.8 (96.9-102.7)	99.2 (96.9-101.5)	101.0 (97.8-104.2)	101.6 (99.7-103.6)	0.70
Non-Hispanic Asian	87.2 (84.0-90.4)	86.1 (83.5-88.6)	88.2 (86.1-90.4)	89.4 (86.4-92.5)	0.16
Other	103.2 (96.9-109.6)	101.4 (93.3-109.5)	104.4 (98.8-110.1)	101.6 (94.6-108.5)	0.87
IPR 1-2.9 [b]					
Hispanic	99.7 (98.3-101.2)	101.6 (99.8-103.3)	100.7 (99.1-102.4)	102.5 (100.5-104.6)	0.10
Non-Hispanic white	100.7 (98.5-102.8)	101.7 (100.0-103.3)	101.3 (98.8-103.9)	101.2 (98.5-103.9)	0.54
Non-Hispanic black	100.2 (97.6-102.8)	102.0 (99.9-104.1)	101.0 (98.6-103.5)	102.3 (99.8-104.8)	0.38
Non-Hispanic Asian	87.9 (85.3-90.4)	88.5 (86.2-90.9)	87.4 (85.5-89.2)	91.4 (89.5-93.3)	0.07
Other	105.3 (99.9-110.6)	105.1 (101.1-109.0)	102.0 (98.6-107.4)	104.3 (100.5-108.1)	0.75
IPR ≥3 [b]					
Hispanic	98.9 (97.2-100.6)	98.2 (95.0-101.3)	102.2 (98.3-106.2)	99.9 (96.9-102.9)	0.26
Non-Hispanic white	97.2 (95.5-99.0)	98.6 (97.0-100.1)	100.0 (98.2-101.9)	100.7 (98.3-103.0)	0.01
Non-Hispanic black	102.4 (99.7-105.1)	100.3 (97.8-102.8)	100.4 (97.7-103.0)	100.8 (98.0-103.6)	0.71
Non-Hispanic Asian	86.9 (85.7-88.1)	88.7 (87.2-90.2)	88.9 (87.2-90.6)	89.6 (88.1-91.2)	0.009
Other	95.7 (91.8-99.6)	94.5 (88.0-100.9)	103.9 (97.9-109.8)	100.9 (95.6-106.2)	0.17

[a] P for trend adjusted for age, sex, and race/ethnicity.
[b] P for trend adjusted for age and sex.

Table R5. Trends in Age-Adjusted Body Fat Percentage by Race/Ethnicity: United State, 2011-2018 (N=10,864)[a]

Variables	Age-adjusted body fat percentage, mean (95%CI)				P for trend
	2011-2012	2013-2014	2015-2016	2017-2018	
Education [b]					
Less than high school	32.1 (31.1-33.2)	32.6 (31.9-33.2)	32.0 (31.1-32.9)	32.9 (31.3-34.5)	0.99
High school	32.8 (31.8-33.8)	32.9 (32.1-33.7)	32.4 (31.3-33.6)	32.9 (31.6-34.1)	0.33
College or higher	32.7 (31.9-33.5)	33.2 (32.5-33.9)	33.2 (32.4-33.9)	33.1 (32.2-34.1)	0.79
Less than high school [c]					
Hispanic	33.4 (31.8-34.9)	33.5 (32.6-34.4)	33.0 (32.0-34.0)	33.4 (32.4-34.3)	0.77
Non-Hispanic white	31.5 (30.0-33.0)	32.6 (31.0-34.1)	31.3 (29.3-33.2)	34.1 (28.0-40.3)	0.91
Non-Hispanic black	30.1 (28.0-32.2)	29.1 (27.6-30.5)	29.6 (26.5-32.8)	29.4 (26.9-31.8)	0.06
Non-Hispanic Asian	29.5 (26.9-32.2)	31.2 (28.1-34.3)	28.6 (26.6-30.7)	31.4 (28.5-34.3)	0.97
Other	32.6 (25.9-39.3)	32.1 (26.5-37.6)	30.0 (24.4-35.6)	31.4 (27.4-35.4)	0.95
High school [c]					
Hispanic	34.5 (32.3-36.7)	33.0 (31.0-34.9)	34.7 (33.3-36.2)	34.8 (33.5-36.1)	0.66
Non-Hispanic white	32.5 (31.3-33.7)	33.1 (32.2-34.0)	32.1 (30.5-33.7)	32.4 (30.1-34.6)	0.20
Non-Hispanic black	32.1 (30.5-33.8)	32.0 (30.4-33.6)	30.4 (28.9-32.0)	30.7 (28.5-33.0)	0.83
Non-Hispanic Asian	30.0 (26.9-33.1)	30.2 (28.2-32.3)	33.4 (29.2-37.6)	32.3 (31.1-33.5)	0.048
Other	34.5 (29.5-39.4)	33.0 (29.7-36.3)	30.7 (25.2-36.2)	34.5 (30.4-38.7)	0.65
College or higher [c]					
Hispanic	33.7 (32.2-35.2)	34.6 (33.4-35.8)	34.5 (33.5-35.6)	34.2 (32.7-35.7)	0.82
Non-Hispanic white	32.7 (31.8-33.5)	33.1 (32.3-34.0)	33.1 (32.1-34.1)	32.9 (31.7-34.2)	0.66
Non-Hispanic black	33.4 (32.5-34.3)	33.7 (32.2-35.3)	33.1 (31.5-34.7)	33.2 (31.9-34.5)	0.99
Non-Hispanic Asian	30.8 (29.8-31.8)	32.0 (31.2-32.8)	31.3 (30.7-31.9)	32.9 (32.1-33.7)	0.002
Other	31.2 (29.3-33.2)	31.6 (28.4-34.9)	33.7 (31.1-36.4)	33.7 (31.8-35.6)	0.08
Income status					

<1	32.4 (31.4-33.4)	33.5 (32.8-34.2)	34.2 (32.8-35.6)	33.9 (32.9-34.9)	0.36
1-2.9	32.9 (32.2-33.7)	33.6 (32.8-34.5)	33.1 (32.7-33.6)	33.0 (31.9-34.2)	0.52
≥3	32.3 (31.5-33.2)	32.6 (31.8-33.3)	32.5 (31.7-33.2)	32.8 (31.7-33.9)	0.94
Missing	31.9 (30.1-33.8)	32.6 (31.2-33.9)	30.9 (28.9-32.9)	33.0 (31.2-34.8)	0.51
IRP<1 [c]					
Hispanic	34.2 (32.6-35.8)	33.9 (32.5-35.4)	35.5 (33.8-37.2)	34.6 (33.0-36.2)	0.41
Non-Hispanic white	31.7 (30.3-33.0)	34.1 (33.1-35.1)	34.7 (32.0-37.3)	34.1 (32.4-35.8)	0.32
Non-Hispanic black	32.4 (30.8-34.0)	32.3 (31.2-33.4)	31.5 (29.5-33.5)	33.8 (31.9-35.6)	0.32
Non-Hispanic Asian	31.4 (29.0-33.8)	29.9 (27.5-32.3)	32.3 (29.9-34.6)	33.1 (31.1-35.1)	0.12
Other	30.5 (24.9-36.2)	31.8 (29.4-34.3)	33.8 (31.0-36.5)	33.2 (30.0-36.4)	0.85
IPR 1-2.9 [c]					
Hispanic	33.2 (31.8-34.7)	34.3 (33.3-35.2)	33.7 (32.9-34.5)	34.5 (33.5-35.5)	0.14
Non-Hispanic white	33.4 (32.3-34.4)	33.6 (32.3-34.9)	33.6 (32.9-34.3)	32.6 (30.7-34.5)	0.10
Non-Hispanic black	32.0 (30.5-33.4)	33.3 (32.1-34.5)	32.0 (30.4-33.7)	32.1 (30.1-34.0)	0.52
Non-Hispanic Asian	29.8 (28.2-31.5)	31.3 (29.8-32.8)	30.5 (29.7-31.4)	32.0 (30.4-33.6)	0.07
Other	32.8 (30.4-35.2)	33.8 (31.5-36.2)	32.0 (28.0-35.9)	33.9 (32.0-35.9)	0.84
IPR ≥3 [c]					
Hispanic	33.8 (32.1-35.4)	33.0 (31.7-34.2)	34.0 (32.9-35.2)	33.2 (30.7-35.8)	0.58
Non-Hispanic white	32.1 (31.2-33.0)	32.7 (31.8-33.7)	32.4 (31.5-33.3)	32.9 (31.6-34.3)	0.82
Non-Hispanic black	33.4 (32.0-34.7)	31.8 (30.1-33.5)	31.8 (30.4-33.3)	30.9 (29.0-32.8)	0.29
Non-Hispanic Asian	31.3 (30.4-32.1)	32.1 (31.2-33.0)	31.7 (31.0-32.4)	32.6 (31.5-33.6)	0.07
Other	31.3 (27.4-35.2)	30.6 (28.1-33.0)	34.5 (31.4-37.5)	33.8 (30.1-37.5)	0.01

[a] percent body fat was available among adults aged 20-59 years.
[b] P for trend adjusted for age, sex, and race/ethnicity.
[c] P for trend adjusted for age and sex.

Table R6. Trends in Age-Adjusted Lean Mass by Race/Ethnicity: United State, 2011-2018 (N=10,864)[a]

Variables	Age-adjusted lean mass, kg, mean (95%CI)				P for trend
	2011-2012	2013-2014	2015-2016	2017-2018	
Education [b]					
Less than high school	51.8 (51.0-52.6)	52.3 (50.7-53.9)	52.0 (50.6-53.4)	51.0 (49.6-52.5)	0.94
High school	54.2 (52.9-55.4)	53.3 (51.5-55.1)	54.5 (53.2-55.8)	52.5 (51.1-53.9)	0.23
College or higher	52.5 (51.6-53.3)	52.5 (51.7-53.3)	52.4 (51.5-53.2)	52.1 (51.1-53.2)	0.78
Less than high school [c]					
Hispanic	50.9 (49.8-51.9)	51.5 (49.9-53.1)	51.1 (49.2-53.1)	51.2 (49.2-53.3)	0.81
Non-Hispanic white	51.8 (50.0-53.5)	53.1 (50.3-55.9)	53.4 (50.9-55.9)	50.6 (45.8-55.4)	0.43
Non-Hispanic black	56.3 (53.8-58.9)	54.0 (51.2-56.9)	54.9 (51.8-58.1)	53.1 (49.5-56.8)	0.36
Non-Hispanic Asian	46.6 (40.8-52.4)	45.0 (38.3-51.6)	42.5 (38.9-46.0)	42.5 (39.9-45.1)	0.38
Other	49.1 (39.4-58.8)	53.6 (46.3-60.8)	58.5 (55.4-61.5)	55.6 (48.8-62.4)	0.41
High school [c]					
Hispanic	52.6 (50.3-55.0)	52.0 (50.1-53.9)	52.3 (50.4-54.2)	51.9 (49.5-54.3)	0.92
Non-Hispanic white	54.2 (52.6-55.9)	53.9 (51.4-56.4)	55.5 (53.6-57.3)	52.3 (50.0-54.6)	0.30
Non-Hispanic black	56.1 (54.6-57.6)	54.8 (52.2-57.5)	56.4 (54.6-58.2)	55.9 (54.1-57.7)	0.23
Non-Hispanic Asian	44.9 (42.1-47.8)	42.0 (39.5-44.5)	43.5 (40.9-46.1)	47.2 (43.6-50.7)	0.004
Other	51.1 (41.6-60.6)	57.3 (52.7-61.9)	54.9 (51.3-58.6)	52.7 (47.5-57.9)	0.71
College or higher [c]					
Hispanic	50.1 (48.6-51.6)	51.8 (50.2-53.5)	51.7 (50.5-52.8)	50.9 (49.5-52.2)	0.09
Non-Hispanic white	52.9 (51.8-54.0)	52.9 (51.8-54.0)	52.7 (51.8-53.6)	52.5 (51.1-54.0)	0.57
Non-Hispanic black	56.1 (55.1-57.2)	55.9 (54.0-57.8)	56.3 (55.2-57.3)	55.2 (53.8-56.7)	0.10
Non-Hispanic Asian	44.5 (43.6-45.3)	44.2 (43.2-45.3)	45.2 (44.4-46.1)	45.6 (44.1-47.0)	0.02
Other	54.9 (48.3-61.5)	53.7 (48.7-58.6)	51.8 (46.2-57.3)	53.6 (50.1-57.0)	0.91
Income status [b]					

<1	51.8 (50.4-53.3)	51.1 (49.9-52.4)	50.8 (49.8-51.8)	50.3 (49.0-51.7)	0.70
1-2.9	53.2 (52.1-54.4)	53.8 (52.6-55.0)	52.8 (51.2-54.3)	52.5 (51.1-54.0)	0.43
≥3	52.9 (51.8-54.0)	52.7 (51.5-53.9)	53.3 (51.9-54.7)	52.5 (51.2-53.9)	0.63
Missing	50.2 (48.4-52.0)	50.4 (48.0-52.8)	52.8 (50.6-55.1)	51.0 (47.5-54.6)	0.32
IRP <1 [c]					
Hispanic	48.7 (46.7-50.7)	50.5 (48.8-52.2)	50.7 (48.8-52.5)	49.1 (46.8-51.4)	0.40
Non-Hispanic white	52.9 (50.8-55.1)	51.4 (48.9-53.9)	51.0 (48.5-53.4)	50.2 (47.8-52.7)	0.93
Non-Hispanic black	54.8 (53.0-56.7)	52.2 (49.8-54.7)	53.4 (51.9-54.9)	54.3 (51.3-57.4)	0.18
Non-Hispanic Asian	41.8 (38.7-44.8)	42.6 (38.2-47.1)	42.3 (39.7-44.9)	43.0 (40.0-46.0)	0.49
Other	54.1 (49.7-58.5)	54.9 (46.4-63.4)	52.1 (44.2-59.9)	53.7 (49.0-58.5)	0.47
IPR 1-2.9 [c]					
Hispanic	52.3 (50.6-53.9)	52.9 (51.6-54.2)	51.9 (50.2-53.5)	52.5 (50.6-54.4)	0.96
Non-Hispanic white	53.1 (51.3-54.9)	54.1 (52.2-56.0)	53.1 (51.3-54.8)	52.0 (49.8-54.2)	0.70
Non-Hispanic black	55.9 (54.4-57.4)	56.2 (54.3-58.1)	56.9 (55.7-58.2)	55.5 (54.2-56.9)	0.30
Non-Hispanic Asian	45.2 (42.9-47.6)	44.7 (42.2-47.1)	43.3 (40.5-46.1)	46.4 (43.9-48.9)	0.24
Other	60.4 (57.1-63.6)	56.8 (53.0-60.5)	54.7 (47.8-61.5)	56.2 (51.1-61.3)	0.22
IPR ≥3 [c]					
Hispanic	51.7 (50.2-53.3)	52.3 (49.2-55.3)	52.9 (50.1-55.7)	52.3 (49.4-55.1)	0.24
Non-Hispanic white	53.6 (52.1-55.0)	53.2 (51.7-54.7)	53.8 (52.0-55.5)	53.1 (51.6-54.6)	0.46
Non-Hispanic black	57.7 (55.4-60.1)	57.0 (54.9-59.2)	56.8 (54.9-58.7)	56.3 (54.3-58.3)	0.07
Non-Hispanic Asian	44.7 (43.6-45.8)	44.0 (42.8-45.1)	46.0 (44.3-47.6)	45.3 (44.4-46.1)	0.09
Other	46.6 (41.2-52.0)	53.1 (46.5-59.8)	51.5 (45.2-57.7)	50.8 (48.5-53.1)	0.36

[a] percent body fat was available among adults aged 20-59 years.

[b] P for trend adjusted for age, sex, and race/ethnicity.

[c] P for trend adjusted for age and sex.

Table R7. Trends in Prevalence of Age-Adjusted General Obesity by Race/Ethnicity: United State, 2011-2018

Variables	Age-adjusted prevalence of general obesity, % (95%CI)				P for trend
	2011-2012	2013-2014	2015-2016	2017-2018	
Education [a]					
Less than high school	38.0 (35.2-40.8)	41.0 (37.6-44.3)	40.0 (35.6-44.5)	41.6 (36.4-46.8)	0.25
High school	40.9 (35.7-46.1)	41.7 (36.8-46.6)	43.5 (38.1-49.0)	47.7 (43.8-51.6)	0.01
College or higher	33.3 (30.1-36.5)	36.6 (34.3-38.8)	39.3 (35.5-43.1)	41.9 (37.1-46.7)	0.002
Less than high school [b]					
Hispanic	42.5 (37.5-47.5)	44.3 (39.2-49.3)	45.9 (38.5-53.4)	41.5 (36.1-47.0)	0.86
Non-Hispanic white	32.7 (28.5-36.9)	37.0 (30.7-43.2)	35.8 (26.1-45.5)	43.1 (29.4-56.7)	0.17
Non-Hispanic black	46.9 (38.5-55.3)	42.6 (33.0-52.3)	38.4 (29.8-47.1)	44.8 (32.5-57.1)	0.32
Non-Hispanic Asian	20.0 (11.8-28.2)	34.1 (18.3-49.9)	20.8 (12.5-29.1)	30.8 (22.0-39.7)	0.55
Other	24.6 (1.1-48.2)	49.8 (22.4-77.3)	46.0 (27.6-64.5)	33.9 (17.5-50.)	0.67
High school [b]					
Hispanic	46.5 (34.9-58.0)	42.0 (35.5-48.5)	46.7 (40.0-53.5)	48.8 (40.7-57.0)	0.64
Non-Hispanic white	38.0 (30.8-45.3)	41.1 (34.1-48.1)	42.0 (35.0-48.9)	46.3 (40.1-52.6)	0.04
Non-Hispanic black	47.7 (41.6-53.9)	48.4 (43.0-53.7)	42.0 (36.7-47.4)	46.8 (39.6-54.0)	0.76
Non-Hispanic Asian	21.9 (14.7-29.0)	16.7 (7.4-26.1)	31.7 (20.7-42.7)	40.0 (28.7-51.4)	0.006
Other	35.6 (18.3-52.9)	39.3 (33.2-45.3)	62.1 (41.3-82.8)	63.3 (51.2-75.4)	0.008
College or higher [b]					
Hispanic	40.5 (35.9-45.2)	41.1 (34.7-47.5)	48.0 (43.2-52.7)	44.5 (38.9-50.1)	0.09
Non-Hispanic white	31.4 (27.8-35.0)	34.8 (32.3-37.3)	36.9 (32.6-41.3)	40.6 (33.9-47.2)	0.01
Non-Hispanic black	48.2 (43.2-53.1)	50.2 (45.2-55.2)	50.1 (44.1-56.1)	52.4 (48.4-56.3)	0.01
Non-Hispanic Asian	20.8 (16.9-24.6)	23.1 (19.8-26.4)	25.4 (18.2-32.5)	33.7 (29.3-38.1)	0.12
Other	38.2 (16.6-59.7)	40.4 (26.2-54.5)	49.8 (40.4-59.2)	40.4 (29.4-51.5)	<0.0001
Income status [a]					

<1	37.6 (33.4-41.7)	40.5 (36.0-45.0)	44.1 (39.2-49.0)	46.4 (41.3-51.5)	0.004
1-2.9	39.5 (35.5-43.5)	44.5 (40.5-48.6)	41.6 (36.6-46.5)	45.7 (41.8-49.5)	0.06
≥3	31.1 (27.0-35.3)	33.8 (30.4-37.2)	38.9 (35.0-42.8)	41.6 (36.1-47.0)	0.001
Missing	35.7 (30.2-41.1)	36.4 (29.8-43.0)	39.6 (34.2-45.0)	39.3 (31.5-47.0)	0.35
IRP<1 [b]					
Hispanic	42.8 (37.1-48.5)	44.2 (36.6-51.8)	53.5 (45.7-61.4)	45.7 (38.8-52.5)	0.09
Non-Hispanic white	31.7 (25.6-37.9)	38.0 (32.4-43.5)	39.8 (32.7-46.9)	46.3 (39.3-53.3)	0.002
Non-Hispanic black	49.3 (42.3-56.3)	44.5 (39.4-49.6)	43.4 (35.4-51.3)	51.5 (44.5-58.5)	0.78
Non-Hispanic Asian	17.7 (9.7-25.7)	29.2 (17.7-40.8)	23.3 (15.9-30.7)	30.9 (19.1-42.7)	0.08
Other	42.4 (23.4-61.4)	40.7 (24.8-56.5)	49.1 (32.3-65.8)	47.8 (33.2-62.3)	0.56
IPR 1-2.9 [b]					
Hispanic	43.6 (38.7-48.5)	45.5 (39.4-51.7)	44.7 (38.6-50.9)	49.7 (44.3-55.0)	0.09
Non-Hispanic white	38.1 (31.9-44.3)	43.8 (38.2-49.5)	39.9 (34.1-45.7)	42.3 (36.4-48.1)	0.29
Non-Hispanic black	45.8 (39.5-52.1)	50.2 (44.3-56.0)	48.7 (42.3-55.1)	49.1 (44.8-53.4)	0.55
Non-Hispanic Asian	21.9 (13.3-30.5)	24.1 (15.6-32.6)	21.3 (11.1-31.6)	37.8 (30.2-45.3)	0.01
Other	45.9 (33.1-58.7)	53.0 (37.5-68.6)	52.0 (34.3-69.8)	57.6 (40.6-74.6)	0.18
IPR ≥3 [b]					
Hispanic	42.5 (36.9-48.1)	36.6 (28.7-44.5)	47.9 (38.3-57.4)	41.5 (31.6-51.4)	0.77
Non-Hispanic white	29.1 (24.3-33.8)	33.2 (29.3-37.1)	37.7 (33.0-42.4)	41.9 (34.5-49.3)	0.003
Non-Hispanic black	49.9 (43.3-56.5)	48.3 (40.0-56.6)	46.3 (39.0-53.7)	51.4 (45.3-57.5)	0.37
Non-Hispanic Asian	20.7 (16.5-25.0)	23.2 (17.8-28.7)	24.5 (19.9-29.2)	29.2 (23.6-34.9)	0.01
Other	26.7 (18.3-35.2)	27.9 (11.1-44.8)	54.4 (36.0-72.7)	33.9 (16.0-51.7)	0.47

[a] P for trend adjusted for age, sex, and race/ethnicity.
[b] P for trend adjusted for age and sex.
obesity was defined using Asian specific cut-off point (BMI ≥27.5 kg/m^2) for Asians

Table R8. Trends in Prevalence of Age-Adjusted Central Obesity by Race/Ethnicity: United State, 2011-2018

Variables	Age-adjusted prevalence of central obesity, % (95%CI)				P for trend
	2011-2012	2013-2014	2015-2016	2017-2018	
Education [a]					
Less than high school	55.9 (53.3-58.6)	57.6 (54.6-60.6)	56.5 (51.9-61.0)	56.9 (51.8-62.1)	0.53
High school	60.0 (53.9-66.2)	60.8 (57.3-64.2)	62.8 (57.5-68.0)	63.0 (59.2-66.7)	0.26
College or higher	52.6 (48.8-56.3)	54.4 (51.7-57.1)	57.4 (52.0-62.8)	57.9 (53.3-62.4)	0.03
Less than high school [b]					
Hispanic	58.5 (53.2-63.9)	64.5 (60.9-68.0)	60.1 (54.3-65.8)	58.9 (52.7-65.1)	0.83
Non-Hispanic white	54.0 (48.9-59.2)	54.4 (49.8-59.0)	58.8 (51.8-65.8)	59.3 (47.2-71.3)	0.32
Non-Hispanic black	56.7 (48.2-65.3)	50.3 (45.5-55.2)	51.0 (45.2-56.8)	58.0 (47.6-68.4)	0.70
Non-Hispanic Asian	28.0 (18.0-38.0)	27.9 (14.7-41.1)	27.3 (19.4-35.3)	26.3 (19.0-33.6)	0.91
Other	57.1 (35.9-78.4)	56.4 (28.8-84.0)	53.0 (31.0-74.9)	43.9 (20.1-67.7)	0.86
High school [b]					
Hispanic	59.7 (50.4-69.0)	57.2 (48.1-65.3)	67.6 (62.1-73.1)	63.9 (56.8-71.0)	0.47
Non-Hispanic white	59.6 (51.3-68.0)	62.1 (55.7-68.4)	65.1 (58.3-72.0)	64.1 (57.6-70.7)	0.31
Non-Hispanic black	61.2 (57.8-65.6)	63.4 (56.6-70.1)	51.9 (45.3-58.4)	59.0 (53.0-65.0)	0.38
Non-Hispanic Asian	28.9 (18.8-39.0)	18.6 (11.7-25.4)	33.6 (17.6-49.6)	33.1 (25.2-40.9)	0.14
Other	73.7 (57.9-89.6)	69.3 (55.0-83.7)	65.1 (41.5-88.7)	77.1 (66.0-88.2)	0.73
College or higher [b]					
Hispanic	55.8 (50.0-61.5)	59.0 (52.5-65.4)	62.1 (56.2-68.0)	59.9 (54.6-65.3)	0.32
Non-Hispanic white	53.0 (48.4-57.6)	54.6 (51.4-57.7)	57.9 (51.7-64.1)	58.3 (52.7-63.8)	0.09
Non-Hispanic black	62.1 (58.4-65.8)	65.3 (59.4-71.1)	63.6 (56.9-70.4)	64.9 (60.8-68.9)	0.32
Non-Hispanic Asian	22.6 (19.2-26.0)	26.8 (22.4-31.2)	25.8 (20.1-31.6)	32.0 (28.6-35.4)	0.001
Other	50.5 (34.5-66.6)	50.8 (36.3-65.3)	65.9 (55.4-76.4)	68.5 (58.7-78.3)	0.02
Income status [a]					

<1	55.8 (51.7-60.0)	59.6 (55.8-62.8)	62.4 (57.7-67.1)	61.4 (56.9-65.9)	0.07
1-2.9	58.6 (54.3-62.8)	63.0 (59.9-66.2)	58.8 (53.7-63.9)	61.2 (56.9-65.5)	0.42
≥3	50.8 (45.5-56.1)	50.8 (48.0-53.60	58.0 (52.4-63.6)	56.7 (51.5-62.0)	0.03
Missing	54.0 (47.4-60.7)	54.3 (47.4-61.3)	49.5 (42.0-57.1)	57.8 (49.2-66.4)	0.45
IRP<1 [b]					
Hispanic	58.2 (52.0-64.5)	61.5 (55.3-67.7)	67.8 (61.5-74.1)	62.1 (55.2-69.0)	0.06
Non-Hispanic white	54.8 (50.2-59.4)	60.1 (54.4-65.8)	64.4 (56.7-72.1)	64.3 (58.3-70.3)	0.04
Non-Hispanic black	61.8 (54.5-69.2)	59.3 (53.6-64.9)	59.3 (53.0-65.7)	63.2 (56.1-70.3)	0.55
Non-Hispanic Asian	23.4 (13.3-33.4)	27.2 (12.1-42.3)	26.8 (18.3-35.4)	26.4 (19.1-33.6)	0.42
Other	67.2 (47.9-86.5)	61.2 (43.8-78.6)	67.0 (46.0-88.0)	62.5 (42.5-82.6)	0.70
IPR 1-2.9 [b]					
Hispanic	59.0 (52.7-65.2)	64.2 (59.1-69.2)	61.0 (58.1-63.9)	64.3 (58.3-70.4)	0.43
Non-Hispanic white	60.2 (54.0-66.3)	64.0 (58.2-69.8)	60.7 (54.5-66.9)	60.2 (52.6-67.8)	0.78
Non-Hispanic black	57.4 (51.9-62.9)	64.4 (58.3-70.5)	59.8 (52.8-66.8)	63.8 (59.5-68.0)	0.20
Non-Hispanic Asian	28.7 (20.6-36.7)	27.8 (22.4-33.2)	24.0 (17.1-31.0)	32.0 (25.0-38.9)	0.72
Other	68.8 (55.1-82.6)	67.8 (56.7-78.8)	66.4 (45.0-87.7)	74.7 (65.7-83.7)	0.29
IPR ≥3 [b]					
Hispanic	56.8 (49.5-64.0)	54.6 (47.6-61.7)	63.2 (57.3-69.1)	55.9 (45.0-66.8)	0.93
Non-Hispanic white	50.7 (45.1-56.4)	52.1 (49.0-55.3)	59.6 (53.4-65.9)	58.4 (52.3-64.5)	0.03
Non-Hispanic black	63.7 (57.3-70.1)	58.9 (50.2-67.6)	58.8 (54.4-63.3)	62.7 (55.4-69.9)	0.62
Non-Hispanic Asian	22.9 (19.1-26.7)	25.7 (18.4-32.9)	26.0 (19.5-32.5)	29.2 (23.6-34.8)	0.06
Other	42.9 (28.0-57.9)	40.6 (24.0-57.3)	63.8 (44.0-83.6)	61.3 (46.0-76.6)	0.046

[a] P for trend adjusted for age, sex, and race/ethnicity.
[b] P for trend adjusted for age and sex.

Comment #6. I understand that age-adjusted estimates were recommended for the NHANES data analysis. However, some adiposity measures like BMI have a J-shaped relationship with adverse health outcomes, with lower BMI in older populations associated with higher risk of mortality. Did the authors perform stratification analysis by age groups and test for interaction between age and ethnicities?

Response: We thank the reviewer for the thoughtful comment. We conducted additional analyses to show the trends by age groups and age*race/ethnicity (Table R9-13). There was no significant interaction between age and race/ethnicity for the trends in adiposity measures except the abdominal obesity rate (P=0.002).

Table R9. Trends in Mean BMI by Age and Race/Ethnicity: United State, 2011-2018 (N=21,093)

Variables	Mean of BMI, kg/m², mean (95%CI)				*P* for trend
	2011-2012	**2013-2014**	**2015-2016**	**2017-2018**	
All participants [a]					
20-39	27.8 (27.2-28.4)	28.6 (28.0-29.3)	28.7 (28.0-29.4)	29.3 (28.4-30.2)	0.008
40-59	29.5 (29.1-30.0)	29.7 (29.0-30.3)	29.9 (29.1-30.7)	30.5 (29.8-31.2)	0.01
≥60	28.7 (28.0-29.4)	29.2 (28.7-29.7)	29.5 (28.9-30.2)	29.6 (29.1-30.1)	0.02
20-39 years [b]					
Hispanic	29.0 (28.1-29.9)	29.6 (28.7-30.5)	30.3 (29.5-31.2)	30.0 (29.0-30.9)	0.07
Non-Hispanic white	27.3 (26.6-28.1)	28.3 (27.4-29.2)	28.3 (27.3-29.2)	29.1 (27.8-30.4)	0.02
Non-Hispanic black	30.5 (29.9-31.2)	30.1 (29.1-31.1)	29.7 (28.7-30.8)	29.9 (28.9-30.9)	0.22
Non-Hispanic Asian	23.9 (23.1-24.7)	24.6 (24.0-25.1)	25.1 (24.5-25.7)	26.3 (25.6-27.1)	<0.0001
Other	26.9 (24.8-29.0)	29.7 (27.7-31.7)	29.9 (28.2-31.6)	30.9 (29.7-32.2)	0.002
40-59 years [b]					
Hispanic	30.2 (29.7-30.8)	30.2 (29.4-31.0)	30.9 (30.3-31.5)	30.8 (30.1-31.5)	0.09
Non-Hispanic white	29.3 (28.7-29.9)	29.5 (28.7-30.4)	29.7 (28.9-30.5)	30.2 (29.2-31.2)	0.10
Non-Hispanic black	31.4 (30.7-32.1)	31.9 (30.6-33.2)	31.8 (30.9-32.8)	33.3 (32.2-34.3)	0.005
Non-Hispanic Asian	25.2 (24.6-25.7)	25.0 (24.4-25.5)	25.0 (24.5-25.5)	26.3 (25.7-26.9)	0.01
Other	31.3 (28.2-34.4)	30.2 (27.6-32.8)	31.5 (29.8-33.2)	31.2 (28.5-33.8)	0.88
≥60 years [b]					
Hispanic	29.6 (28.6-30.6)	29.6 (29.1-30.2)	30.5 (29.7-31.4)	30.2 (29.9-30.5)	0.09
Non-Hispanic white	28.6 (27.7-29.5)	29.3 (28.7-29.9)	29.6 (28.8-30.4)	29.7 (29.1-30.4)	0.02
Non-Hispanic black	30.4 (29.5-31.3)	30.5 (29.6-31.3)	30.0 (29.3-30.7)	30.5 (29.7-31.2)	0.88
Non-Hispanic Asian	24.7 (24.1-25.2)	24.9 (24.0-25.7)	24.6 (23.9-25.4)	25.9 (25.1-26.7)	0.02
Other	30.8 (27.8-33.7)	26.6 (22.8-30.3)	30.1 (27.3-32.9)	29.0 (27.9-30.0)	0.53

[a] P for trend adjusted for sex, and race/ethnicity.

[b] P for trend adjusted for sex.

Table R10. Trends in Mean Waist Circumference by Age and Race/Ethnicity: United State, 2011-2018 (N=20,080)

Variables	Mean of waist circumference, kg/m^2, mean (95%CI)				P for trend
	2011-2012	2013-2014	2015-2016	2017-2018	
All participants [a]					
20-39	94.2 (92.6-95.9)	95.7 (94.1-97.3)	96.3 (94.5-98.1)	96.7 (94.3-99.1)	0.07
40-59	100.8 (99.8-101.8)	101.1 (99.8-102.4)	101.7 (99.9-103.5)	102.5 (100.7-104.3)	0.07
≥60	101.8 (100.0-103.6)	102.7 (101.5-103.9)	103.8 (102.1-105.4)	103.8 (102.2-105.4)	0.055
20-39 years [b]					
Hispanic	96.4 (93.7-99.0)	98.0 (95.6-100.4)	98.6 (97.0-100.1)	97.9 (96.0-99.9)	0.28
Non-Hispanic white	94.0 (94.8-96.2)	95.6 (93.2-98.1)	96.2 (93.8-98.7)	97.3 (93.8-100.7)	0.09
Non-Hispanic black	97.7 (95.7-99.6)	96.3 (93.6-99.0)	96.7 (93.6-99.7)	94.7 (92.4-97.1)	0.07
Non-Hispanic Asian	84.0 (82.0-86.1)	86.1 (84.7-87.4)	87.4 (86.0-88.8)	88.4 (86.3-90.6)	0.002
Other	91.3 (85.9-96.8)	97.7 (93.5-101.9)	98.6 (94.9-102.3)	100.8 (96.7-104.9)	0.01
40-59 years [b]					
Hispanic	100.5 (99.1-101.9)	100.8 (98.5-103.0)	102.4 (101.4-103.5)	102.6 (100.5-104.7)	0.04
Non-Hispanic white	101.3 (100.0-102.5)	101.7 (99.7-103.6)	102.1 (100.0-104.2)	102.3 (100.0-104.7)	0.36
Non-Hispanic black	102.7 (101.5-104.0)	103.6 (100.7-106.6)	103.8 (101.4-106.2)	107.4 (105.0-109.9)	0.001
Non-Hispanic Asian	89.2 (87.8-90.5)	89.3 (87.9-90.7)	88.9 (87.6-90.2)	91.7 (90.2-93.1)	0.02
Other	103.6 (95.7-111.5)	101.1 (93.0-109.2)	105.2 (100.1-110.3)	105.1 (99.3-110.9)	0.52
≥60 years [b]					
Hispanic	101.9 (99.8-104.1)	102.2 (100.3-104.1)	104.0 (102.4-105.6)	103.4 (102.6-104.3)	0.07
Non-Hispanic white	102.0 (99.9-104.1)	103.4 (101.9-104.9)	104.6 (102.5-106.7)	104.7 (102.6-106.7)	0.04
Non-Hispanic black	102.6 (100.5-104.7)	103.8 (101.5-106.0)	102.8 (100.9-104.7)	102.8 (101.4-104.2)	0.89
Non-Hispanic Asian	90.2 (89.1-91.4)	90.4 (87.9-92.9)	89.7 (88.0-91.5)	92.8 (91.3-94.3)	0.01
Other	110.1 (104.0-116.2)	99.2 (89.7-108.7)	106.2 (99.8-112.6)	104.3 (101.0-107.7)	0.26

[a] P for trend adjusted for sex, and race/ethnicity.

[b] P for trend adjusted for sex.

Table R11. Trends in Body Fat Percentage by Age and Race/Ethnicity: United State, 2011-2018 (N=10,864)[a]

Variables	Mean of body fat percentage, mean (95%CI)				*P* for trend
	2011-2012	2013-2014	2015-2016	2017-2018	
All participants [b]					
20-39	31.3 (30.6-32.0)	32.2 (31.4-33.0)	31.6 (30.9-32.2)	31.9 (31.0-32.9)	0.49
40-59	34.0 (33.1-35.0)	34.0 (33.3-34.7)	34.3 (33.6-35.0)	34.3 (33.5-35.0)	0.59
20-39 years [c]					
Hispanic	32.7 (31.3-34.1)	33.3 (32.2-34.3)	33.1 (32.2-34.0)	32.9 (31.6-34.2)	0.90
Non-Hispanic white	31.0 (30.2-31.9)	32.1 (30.8-33.5)	31.3 (30.3-32.2)	31.8 (30.6-33.0)	0.52
Non-Hispanic black	31.3 (30.4-32.2)	31.0 (29.7-32.3)	30.1 (28.5-31.7)	29.4 (27.0-31.8)	0.08
Non-Hispanic Asian	29.3 (28.1-30.6)	31.1 (30.4-31.9)	30.9 (30.0-31.7)	32.0 (31.2-32.8)	0.001
Other	30.5 (28.5-32.5)	31.5 (29.8-33.2)	32.7 (29.9-35.5)	34.3 (31.5-37.2)	0.02
40-59 years [c]					
Hispanic	34.8 (33.1-36.4)	34.4 (33.3-35.6)	35.0 (34.0-36.0)	35.5 (34.5-36.4)	0.32
Non-Hispanic white	34.1 (32.9-35.3)	34.1 (33.2-35.0)	34.4 (33.5-35.2)	34.0 (32.8-35.2)	0.96
Non-Hispanic black	33.9 (33.0-34.8)	34.2 (33.0-35.3)	33.9 (32.7-35.1)	34.8 (33.5-36.1)	0.37
Non-Hispanic Asian	32.0 (31.2-32.8)	32.2 (31.3-33.2)	31.9 (30.8-33.0)	33.5 (32.3-34.6)	0.06
Other	33.3 (29.8-36.8)	32.4 (29.2-35.7)	33.6 (29.4-37.8)	33.5 (31.3-35.7)	0.73

[a] percent body fat was available among adults aged 20-59 years.

[b] P for trend adjusted for sex, and race/ethnicity.

[c] P for trend adjusted for sex.

Table R12. Trends in Lean Mass by Age and Race/Ethnicity: United State, 2011-2018 (N=10,864)[a]

Variables	Mean of lean mass, kg, mean (95%CI)				P for trend
	2011-2012	2013-2014	2015-2016	2017-2018	
All participants					
20-39	52.6 (51.6-53.6)	52.2 (51.3-53.1)	52.9 (51.9-53.9)	52.1 (51.0-53.2)	0.75
40-59	52.8 (51.7-53.9)	53.1 (52.0-54.2)	52.6 (51.7-53.6)	52.1 (50.8-53.4)	0.31
20-39 years					
Hispanic	51.3 (49.8-52.8)	52.1 (50.4-53.7)	52.1 (51.2-52.9)	52.7 (50.8-54.5)	0.25
Non-Hispanic white	52.9 (51.6-54.2)	52.6 (51.4-53.9)	53.5 (52.1-54.9)	52.1 (50.5-53.8)	0.67
Non-Hispanic black	57.2 (56.0-58.4)	54.3 (51.5-57.2)	56.4 (55.1-57.6)	54.1 (52.3-55.8)	0.03
Non-Hispanic Asian	44.6 (43.4-45.9)	43.9 (42.3-45.4)	45.5 (44.7-46.4)	46.5 (44.3-48.7)	0.04
Other	52.2 (47.5-56.9)	54.5 (50.7-58.4)	51.5 (47.3-55.6)	53.7 (50.1-57.4)	0.89
40-59 years					
Hispanic	50.5 (49.1-52.0)	51.4 (50.0-52.9)	51.1 (50.0-52.2)	50.0 (48.1-52.0)	0.56
Non-Hispanic white	53.3 (51.8-54.8)	53.6 (52.1-55.1)	53.2 (52.1-54.2)	52.6 (51.0-54.2)	0.44
Non-Hispanic black	54.9 (53.7-56.1)	56.3 (54.9-57.8)	55.9 (55.0-56.8)	56.5 (55.0-57.9)	0.11
Non-Hispanic Asian	44.5 (43.1-45.9)	44.0 (43.1-44.9)	43.9 (42.5-45.3)	44.6 (43.2-45.9)	0.88
Other	55.0 (48.8-61.1)	54.5 (47.3-61.7)	55.4 (46.9-63.9)	54.6 (50.7-58.4)	0.97

[a] percent body fat was available among adults aged 20-59 years.

[b] P for trend adjusted for sex, and race/ethnicity.

[c] P for trend adjusted for sex.

Table R13. Trends in Prevalence of General Obesity and Abdominal Obesity by Age and Race/Ethnicity: United State, 2011-2018

Variables	Prevalence, % (95%CI)				P for trend
	2011-2012	2013-2014	2015-2016	2017-2018	
General Obesity defined by BMI (N=21,093)					
All participants [a]					
20-39	30.7 (26.8-34.6)	34.8 (31.7-37.9)	36.5 (32.8-40.3)	40.9 (35.4-46.3)	0.002
40-59	40.2 (36.9-43.4)	41.5 (37.3-45.8)	43.6 (38.2-49.0)	46.1 (42.4-49.8)	0.01
≥60	35.8 (31.6-40.0)	39.1 (35.6-42.6)	41.6 (37.7-45.5)	43.5 (38.3-48.7)	0.01
20-39 years [b]					
Hispanic	39.0 (33.0-45.1)	41.2 (35.2-47.2)	44.2 (39.7-48.6)	44.5 (37.8-51.2)	0.15
Non-Hispanic white	26.2 (21.3-31.1)	31.2 (27.4-35.1)	33.0 (27.4-38.6)	39.2 (31.3-47.0)	0.003
Non-Hispanic black	46.0 (40.3-51.7)	45.2 (38.7-51.6)	40.0 (32.6-47.5)	41.5 (35.9-47.0)	0.13
Non-Hispanic Asian [c]	17.5 (11.9-23.2)	25.9 (20.9-30.8)	28.5 (21.1-35.8)	33.7 (28.0-39.4)	0.0001
Other	25.1 (12.1-38.0)	35.4 (24.3-46.5)	47.3 (37.0-57.7)	54.0 (40.9-67.0)	0.001
40-59 years [b]					
Hispanic	46.0 (39.7-52.2)	46.3 (41.3-51.4)	50.0 (43.9-56.1)	45.9 (40.5-51.2)	0.81
Non-Hispanic white	38.7 (34.1-43.2)	40.3 (34.1-46.5)	41.2 (35.4-47.0)	43.9 (37.7-50.1)	0.16
Non-Hispanic black	49.3 (4.5-54.2)	52.1 (44.5-59.6)	54.9 (47.9-61.9)	60.5 (55.0-65.9)	0.003
Non-Hispanic Asian [c]	25.1 (19.4-30.8)	21.7 (17.0-26.4)	23.3 (15.1-31.4)	38.7 (30.7-46.7)	0.007
Other	36.7 (19.9-53.4)	42.4 (21.9-62.8)	56.9 (40.5-73.4)	49.1 (31.4-66.8)	0.29
≥60 years [b]					
Hispanic	42.8 (35.9-49.6)	38.9 (32.1-45.7)	47.1 (41.1-53.1)	43.5 (38.5-48.5)	0.42
Non-Hispanic white	34.0 (29.2-38.8)	39.1 (34.7-43.4)	41.1 (36.0-46.3)	44.8 (37.3-52.3)	0.01
Non-Hispanic black	48.5 (42.5-54.5)	47.9 (41.2-54.6)	45.4 (40.7-50.1)	46.2 (40.1-52.4)	0.48
Non-Hispanic Asian [c]	19.5 (14.6-24.4)	22.3 (14.7-29.9)	24.2 (16.3-32.1)	27.9 (21.5-34.3)	0.04

Other	50.0 (25.7-74.3)	35.3 (12.8-57.8)	51.5 (26.1-76.9)	28.8 (14.5-43.0)	0.19

Abdominal obesity defined by waist circumference (N=20,080)

All participants [a]

20-39	40.8 (35.9-45.8)	44.7 (41.6-47.8)	46.5 (42.2-50.8)	47.3 (41.7-52.9)	0.06
40-59	60.8 (57.1-64.5)	59.9 (56.7-63.0)	63.1 (57.3-69.0)	63.4 (58.9-68.0)	0.21
≥60	67.9 (63.3-72.6)	70.3 (66.1-74.5)	71.2 (65.6-76.8)	72.5 (68.5-76.6)	0.12

20-39 years [b]

Hispanic	48.1 (42.0-54.2)	53.3 (47.3-59.2)	52.2 (48.4-55.9)	51.3 (45.9-56.6)	0.49
Non-Hispanic white	38.6 (31.5-45.7)	42.4 (37.5-47.3)	46.4 (40.6-52.1)	47.5 (39.0-56.0)	0.06
Non-Hispanic black	52.7 (47.2-58.2)	51.5 (46.7-56.2)	47.3 (39.7-54.9)	45.2 (39.3-51.1)	0.03
Non-Hispanic Asian [c]	17.7 (12.5-22.9)	23.0 (15.4-30.6)	23.8 (17.6-30.0)	21.9 (16.4-27.4)	0.27
Other	32.2 (14.7-49.8)	45.1 (34.7-55.5)	54.1 (41.2-67.1)	68.8 (58.5-79.1)	0.0003

40-59 years [b]

Hispanic	63.9 (57.0-70.7)	63.1 (55.8-70.3)	65.0 (59.8-70.2)	62.4 (57.2-67.6)	0.85
Non-Hispanic white	61.8 (57.5-66.0)	60.9 (55.9-65.8)	65.2 (58.9-71.5)	64.2 (58.0-70.3)	0.30
Non-Hispanic black	64.3 (59.2-69.4)	67.8 (61.4-74.2)	65.3 (58.1-72.6)	75.3 (69.1-81.6)	0.02
Non-Hispanic Asian [c]	26.9 (22.5-31.2)	23.5 (18.1-28.9)	25.5 (18.5-32.5)	37.2 (33.2-41.2)	0.002
Other	67.6 (43.7-91.5)	56.1 (36.5-75.7)	70.4 (51.8-88.9)	61.6 (45.9-77.3)	0.90

≥60 years [b]

Hispanic	64.7 (60.3-69.1)	68.3 (62.0-74.5)	75.9 (72.8-79.1)	73.8 (70.7-77.0)	0.0001
Non-Hispanic white	69.7 (63.8-75.6)	72.5 (67.4-77.7)	72.9 (65.8-80.1)	74.4 (69.7-79.0)	0.21
Non-Hispanic black	69.1 (64.8-73.4)	71.1 (63.9-78.3)	68.7 (64.0-73.4)	70.7 (66.9-74.5)	0.79
Non-Hispanic Asian [c]	33.1 (29.0-37.2)	34.2 (25.8-42.7)	33.9 (24.5-43.4)	40.5 (31.4-49.5)	0.15
Other	75.1 (39.4-100.0)	62.3 (33.1-91.5)	75.0 (55.5-94.4)	78.7 (64.9-92.5)	0.71

[a] P for trend adjusted for sex, and race/ethnicity.

[b] P for trend adjusted for sex.

[c] obesity was defined using Asian specific cut-off point (BMI ≥27.5 kg/m2) for Asians

Comment #7. Despite its many drawbacks, BMI remains the most commonly used adiposity index in clinical practice and probably deservingly so. Did the authors assess whether statistically significant trends in other adiposity measures were not fully explained by BMI i.e. did the authors adjust the analyses for BMI (or at least height)?

Response: We thank the reviewer for the comment. We did not adjust BMI when calculating the significance of the trend because the objective of the study was to examine the trend of these obesity and adiposity measures separately. However, we agree with the reviewer that it would be interesting to understand the meaning of other adiposity measures beyond BMI. Therefore, we performed new analyses with additional adjustment for BMI and show the results below based on the reviewer's comment (Table R14). We noticed that some of the significant trends were attenuated or distorted, but the significant increasing trends in body fat percentage in male non-Hispanic Asians remained.

Table R8. P for trends after additional adjustment for BMI

Variables	Waist circumference		Body fat percent		Lean mass		Central obesity	
	P for trend [a]	P for trend (adjust for BMI) [b]	P for trend [a]	P for trend (adjust for BMI) [b]	P for trend [a]	P for trend (adjust for BMI) [b]	P for trend [a]	P for trend (adjust for BMI) [b]
Overall	0.01	0.20	0.93	0.053	0.98	0.35	0.02	0.88
All participants								
Hispanic	0.04	0.20	0.53	0.77	0.27	0.97	0.24	0.21
Non-Hispanic white	0.03	0.14	0.42	0.04	0.66	0.82	0.052	0.91
Non-Hispanic black	0.50	0.34	0.69	0.84	0.04	0.02	0.75	0.89
Non-Hispanic Asian	<0.0001	0.69	0.001	0.16	0.01	0.67	0.001	0.49
Other	0.21	0.61	0.06	0.50	0.76	0.046	0.04	0.37
Male								
Hispanic	0.048	0.64	0.31	0.75	0.26	0.91	0.20	0.16
Non-Hispanic white	0.042	0.48	0.44	0.10	0.83	0.29	0.02	0.67
Non-Hispanic black	0.52	0.51	0.67	0.71	0.81	0.12	0.36	0.40
Non-Hispanic Asian	<0.0001	0.07	**< 0.0001**	**0.001**	0.01	0.40	0.01	0.95
Other	0.88	0.72	0.62	0.86	0.53	0.08	0.30	0.18
Female								
Hispanic	0.19	0.08	0.82	0.37	0.65	0.81	0.73	0.69
Non-Hispanic white	0.09	0.11	0.65	0.21	0.28	0.34	0.41	0.85
Non-Hispanic black	0.66	0.04	0.32	0.91	0.03	0.09	0.68	0.51

Non-Hispanic Asian	0.08	0.31	0.32	0.82	0.23	0.54	0.03	0.32
Other	0.01	0.71	0.01	0.35	0.07	0.32	0.004	0.98

[a] original P for trend reported in the manuscript
[b] P for trend additionally adjusted for BMI

Comment #8. The authors have correctly used different adiposity measures, but I feel there is a lack of deliberation in using or interpreting these markers. What does each adiposity measures represent biologically? How is the concordance between different measures? What roles could other measures have on top of BMI in clinical practice, based on the current study findings and previous studies?

Response: We thank the reviewer for the comments. We have added a paragraph to describe these measures in the introduction (Page 5 Line 9-15).

Minor

Comment #9. Please clarify in the abstract and methods that the number for participants cited are the total number of respondents for the whole period.

Response: We thank the reviewer for the comment. We have clarified it in the abstract (Page 3, Line 18) and the method section (Page 7 Line 17-18).

Comment #10. I'm not sure whether it is useful to present weight and height trends alone without context, especially the former, unless adjusted for each other. Please describe findings in the Results if presenting the tables.

Response: We thank the reviewer for the comment. We have removed these results.

Reviewer: 4

Comments:
Thank you for inviting me to review for this manuscript.

In this manuscript, Liu and colleagues used the NHANES 2011-2018 data to examine the trends in obesity and adiposity measures by race/ethnicity and sex among adults in the United States. The significance of this study is two-fold. First, the authors were able to include body fat percentage and lean mass as measures of adiposity. Second, the authors were able to assess the trends in obesity and adiposity for Asian people in the United States. The analyses were well conducted, and the results were nicely presented. As the authors pointed out, tracking the obesity prevalence is important to inform policy and prevention programs.

I have a few comments that the authors should clarify.

Comment #1. Summary Boxes: "What is already known on this topic" currently presents an overview of research gaps instead of what is already known on this topic.
Response: We thank the reviewer for the comment. We have revised this to make it more explicit (Page 2 Line 4-5).

Comment #2. Introduction: The authors mentioned that the whole-body dual-energy X-ray absorptiometry (DXA) was administered since the NHANES 2011-2012 cycle. This is misleading because whole-body DXA was also conducted in previous cycles and the authors did mention this later in the manuscript (Reference 31).
Response: We thank the reviewer for the comment. We have removed "Since the 2011-2012 cycle" (Page 5 Line 21).

Comment #3. Methods, Other variables: As race/ethnicity is a major covariate in this analysis, more details on how race/ethnicity was assessed are needed. This information was obtained from a standardized questionnaire, and the original question in the questionnaire should be provided. A few other details are also needed, for example: Were translations provided for people who did

not speak or were not fluent in English? How was the non-Hispanic Asian population defined? How were participants with multiple racial/ethnic background classified? Please also define "other race/ethnicity" in the manuscript and in the Table footnotes.

Response: We thank the reviewer for the comment. A detailed description has been added in the method section (Page 9 Line 2-20) and the table footnotes.

Comment #4. Results: The authors did observe many interesting sex-specific trends in obesity and adiposity measures. Space allows, this observation should be mentioned in the Abstract and its implications should be discussed in Discussion.

Response: We thank the reviewer for the comment. We have added the point in the discussion section as suggested (Page 15 Line 21; Page 18 Line 8-9). However, we did not add it in the abstract because of limited space.

Comment #5. References: This manuscript overlaps with some published studies. A quick search led me to this article (https://pubmed.ncbi.nlm.nih.gov/28841875/) that described waist circumference in non-Hispanic Asians in the NHANES 2011-2014 cycles. There are likely to be more and the authors should reference these studies and discuss what this current study adds.

Response: We thank the reviewer for the careful review. This study has been cited in the original manuscript, which is ref [19]. According to the reviewer's comment, we added a discussion about it in the discussion section (Page 16, Line 17-18).

Comment #6. Tables: Table 1 header reads "mean of age-adjusted mean BMI, kg/m2, mean (95% CI)". The first two words "mean of" should be taken out. This applies to other table headers.

Response: Done.

Comment #7. Appendix Figure 1: A total of 1777 participants (~13% of the study population) did not have valid DXA data due to "other reasons". What are these reasons? Have the authors considered a sensitivity analysis to address this potential source of selection bias? This should be acknowledged in Limitations if additional analyses are not feasible.

Response: We thank the reviewer for the comment. Other reasons include participant refusal, and medical tests, etc. We have revised the figure to clarify (Appendix Figure 1). A limitation has been added as suggested (Page 19, Line 6-9).

Comment #8. This manuscript could benefit from closer re-reading and revision of language. Statistics in the Result section were also not shown in a consistent fashion. For example, some used "(95% CI xx-xx)" when providing confidence intervals while some used "(xx-xx)".

Response: We thank the reviewer for the careful review. We have re-read the manuscript and revised the text to keep consistent (Page 4 Line 1; Page 11 Line 6,7,14; Page 12 Line 1, 13,15,16; Page 13 Line 2,3,4,5,7,14,15,22,23).

Reviewer: 5

Comments:
This descriptive study assesses trends in obesity and adiposity measures between 2011 and 2018 using data from four two-year cycle cross-sectional surveys within the large US-based NHANES study.

The NHANES surveys are designed to produce a national representative sample given appropriate sampling weights which calibrate to race-Hispanic origin-sex-education level-household income, and should enable the derivation of stable estimates for each cycle.

The statistical approach used in this study to investigate linear trends over time (multivariable linear regression adjusting for age, race/ethnicity and sex where appropriate) seems reasonable given that only four time points were available. In addition, the sample sizes of the various sub-categories appear sufficient to estimate the trends with suitable precision (see Appendix Table 1). The sizes of the various sub-categories are approximately halved for body fat percentage and lean mass. However, the numbers are still adequate for these outcomes.

There are just a couple of issues which need to be addressed:

Comment #1. Figures should be added to the paper to illustrate the trends over time presented in Tables 1 to 5. At present, it is difficult to interpret the size of the actual trend differences between the various race/ethnic groups. These are quite subtle in some instances. For example, the BMI changes presented in Table 1 show a statistically significant upward trend for the Hispanic subgroup (an overall increase of 0.7 [relative increase of 2.4%] over the time period) but a non-significant trend for the non-Hispanic black subgroup (an increase of 0.5 [relative increase of 1.6%] over the time period).
Response: We thank the reviewer for the comment. We have added a figure to show the trends in various adiposity measures over time (Figure 1).

Comment #2. Numerous trend tests are carried out (n=80 in all for Tables 1 to 5), hence the

researchers need to acknowledge the problem of multiple testing and the effect on the type I error. The interpretation of 'significant' trends also needs to include the size of the changes over time (see point 1 above).

Response: We thank the reviewer for the thoughtful comment. In line with previous CDC reports,[1 12-14] we did not make adjustments for multiple testing in the current study. However, we totally concur with the reviewer that we should acknowledge the problem of multiple testing. Therefore, as the reviewer suggested, we added sentences in the limitation section to acknowledge the problem of multiple testing: increasing the chance of the type I error (Page 19 Line 9-10). We have added descriptions of the size of the changes over time and removed the word "significant" from the discussion.

Reference:

1. Hales CM, Fryar CD, Carroll MD, et al. Differences in Obesity Prevalence by Demographic Characteristics and Urbanization Level Among Adults in the United States, 2013-2016. *Jama* 2018;319(23):2419-29. doi: 10.1001/jama.2018.7270 [published Online First: 2018/06/21]

2. Hales CM CM, Fryar CD, Ogden CL. Prevalence of obesity and severe obesity among adults: United States, 2017–2018 Hyattsville, MD: National Center for Health Statistics; 2020 [accessed 04/20 2020.

3. Hales CM, Fryar CD, Carroll MD, et al. Trends in Obesity and Severe Obesity Prevalence in US Youth and Adults by Sex and Age, 2007-2008 to 2015-2016. *Jama* 2018;319(16):1723-25. doi: 10.1001/jama.2018.3060 [published Online First: 2018/03/24]

4. National Center for Health Statistics. National Health and Nutrition Examination Survey: Analytic Guidelines, 2011-2014 and 2015-2016 2018 [updated Sep. Available from: https://wwwn.cdc.gov/nchs/data/nhanes/analyticguidelines/11-16-analytic-guidelines.pdf accessed 02/25 2020.

5. Chen TC CJ, Riddles MK, Mohadjer LK, Fakhouri THI. National Health and Nutrition Examination Survey, 2015−2018: Sample design and estimation procedures. *National Center for Health Statistics* 2020;Vital Health Stat 2(184)

6. Kaufman JS. Statistics, Adjusted Statistics, and Maladjusted Statistics. *Am J Law Med* 2017;43(2-3):193-208. doi: 10.1177/0098858817723659 [published Online First: 2017/12/20]

7. Ogden CL, Fryar CD, Martin CB, et al. Trends in Obesity Prevalence by Race and Hispanic Origin-1999-2000 to 2017-2018. *Jama* 2020;324(12):1208-10. doi: 10.1001/jama.2020.14590 [published Online First: 2020/08/29]

8. Ford ES, Maynard LM, Li C. Trends in mean waist circumference and abdominal obesity among US adults, 1999-2012. *Jama* 2014;312(11):1151-3. doi: 10.1001/jama.2014.8362 [published Online First: 2014/09/17]

9. Flegal KM, Carroll MD, Ogden CL, et al. Prevalence and trends in obesity among US adults, 1999-2008. *Jama* 2010;303(3):235-41. doi: 10.1001/jama.2009.2014 [published Online First: 2010/01/15]

10. Annual Estimates of the Resident Population by Sex, Race, and Hispanic Origin for the United States: April 1, 2010 to July 1, 2019 (NC-EST2019-SR11H). In: U.S. Census Bureau, Population Division, eds., June 2020.

11. Ingram DD, Malec DJ, Makuc DM, et al. National Center for Health Statistics Guidelines for Analysis of Trends. *Vital Health Stat 2* 2018(179):1-71. [published Online First: 2018/05/19]

12. Cao J, Zhang S. Multiple Comparison Procedures. *JAMA* 2014;312(5):543-44. doi: 10.1001/jama.2014.9440

13. Ogden CL, Carroll MD, Lawman HG, et al. Trends in Obesity Prevalence Among Children and Adolescents in the United States, 1988-1994 Through 2013-2014. *JAMA* 2016;315(21):2292-99. doi: 10.1001/jama.2016.6361

14. Ogden CL, Carroll MD, Kit BK, et al. Prevalence of childhood and adult obesity in the United States, 2011-2012. *Jama* 2014;311(8):806-14. doi: 10.1001/jama.2014.732 [published Online First: 2014/02/27]