26-Sep-2020
BMJ-2020-060315 entitled "Trends in obesity and adiposity measures by race/ethnicity among adults in the United States: 2011-2018"

Dear Dr. Liu,

Thank you for sending us your paper. We sent it for external peer review and discussed it at our manuscript committee meeting. We are interested in proceeding with it, provided you are willing and able to revise your paper as explained below in the report from the manuscript meeting.

Please remember that the author list and order were finalised upon initial submission, and reviewers and editors judged the paper in light of this information, particularly regarding any competing interests. If authors are later added to a paper this process is subverted. In that case, we reserve the right to rescind any previous decision or return the paper to the review process. Please also remember that we reserve the right to require formation of an authorship group when there are a large number of authors.

When you return your revised manuscript, please note that The BMJ requires an ORCID iD for corresponding authors of all research articles. If you do not have an ORCID iD, registration is free and takes a matter of seconds.

Sincerely,
Elizabeth Loder, MD, MPH

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Report from The BMJ's manuscript committee meeting

Present: John Fletcher; David Ludwig; Joseph Ross; Tiago Villanueva; Wim Weber

Decision: Request revisions after stats report

* 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..."

* 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?

* 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.

* 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?

* 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.

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.

Comments from Reviewers

Recommendation:

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:

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.

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."

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

4. Can you separate visceral fat and subcutaneous fat?

Additional Questions:
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Please enter your name: Anna E. Ssentongo

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Institution: Penn State University

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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
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]

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.]

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

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.

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Please enter your name: Laura Rosella

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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
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?
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?
3. How was missing data handled?
4. A visualisation of growth in adiposity measures over the survey years would be highly informative
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?
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?
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)?
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?

Minor
1. Please clarify in the abstract and methods that the number for participants cited are the total number of respondents for the whole period.
2. 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.

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Please enter your name: Wahyu Wulaningsih

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Reimbursement for attending a symposium?: No

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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.

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.

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).

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.

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.

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.

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.

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.

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)".

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Please enter your name: Mingyu Zhang

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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:

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).

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).

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