



Dr Nikola Koepke
Postdoc Researcher
phone +41 44 635 05 36
nikola.koepke@iem.uzh.ch

Revision manuscript Koepke et al. Article ID: 12914
Rebuttal letter

Zurich, 2nd Dec. 2016

Dear Editors,

We thank you and the reviewers for their time and effort spend on assessing and commenting in detail on our manuscript.

We replied to every comment, considered the suggested technical changes, and edited the manuscript accordingly.

Please find attached our response to all the reviewers and the editor.

After addressing all concerns, we believe that the manuscript is suitable for publication in PeerJ now.

Yours sincerely

A handwritten signature in cursive script that reads 'Nikola Koepke'.

Dr Nikola Koepke

Postdoc Evolutionary Morphology and Adaption Group/ Institute of Evolutionary Medicine/
UZH

On behalf of all authors.

Response Editor and Reviewers' Comments

1. Answers to the comments by the Editor

- “The correlation coefficient is not a good measure of agreement as it can still be high despite a considerable systematic difference (as demonstrated in this study). The better way would be to use Lin’s concordance correlation coefficient (Lin 1989), which adjusts Pearson’s r by a bias correction factor. There is a Stata command by Nick Cox to calculate the CCC (use “ssc install concord” within Stata). Lin LI. A concordance correlation coefficient to evaluate reproducibility. *Biometrics*. 1989; 45: 255-68.”

***Answer:** Thank you very much for this excellent suggestion. We proceeded accordingly and calculated Lin’s concordance correlation coefficients. We added the results (CCC, r , C_b) to Table 3. We also added corresponding sentences to the statistical methods and results sections.*

- “Have the investigators tried to perform the height measurement in the scanner with legs close together (in addition to legs apart) and used the former to measure height? Is there some data to back that claim in lines 384-6?”

***Answer:** Thank you very much. Actually, we already have planned to test this hypothesis in future studies. Unfortunately, we cannot go back in time and test it on the presented data. So far, to the best of our knowledge, there don’t exist studies to back up our claim you are referring to, but it is based on the Theorem of Pythagoras. Yet, to tone down our statement we now speak of “hypothetical” factors and we added a sentence at the end of this paragraph saying that future studies should test these potentially biasing factors.*

- “Harmonize the spelling in the manuscript: It should be either British or US but not both. It appears to be leaning towards British spelling so it’s probably easiest to replace “standardized” with “standardised” throughout (I may have missed other US spelled words).”

***Answer:** Thank you for pointing on this inconsistency. We harmonised the spelling to British English.*

- “Lines 223-224: Please correct the BMI formula (kg/m²)”

***Answer:** Thank you for spotting this mistake. Apparently, the superscripted “^2” got lost in transformation from Word to PDF during online submission. To ensure that this won’t happen again we abandoned superscripts and left it at “m2” in the current version.*

- “Line 266: replace “waver” with “waiver””

***Answer:** Done.*

- “Line 344: replace “insignificant” with “non-significant””

***Answer:** Done.*

- “Line 345: replace “clearest” with “strongest””

***Answer:** Done.*

- “Line 379: replace “contradicts” with “conflicts with””

***Answer:** Done.*

- “Line 439: please reword as there can’t be confounding with this study design”

***Answer:** We replaced “confounding” with “biasing”.*

- “Line 446: replace “training state” with “experience” or “training level””

***Answer:** Thanks. We used “training level”.*

- “Line 446: replace “We took effort” with “We made an effort””

***Answer:** Done.*

- “Line 447: again, confounding requires an exposure-outcome relationship; these are rather sources of random error”

***Answer:** We replaced “confounders” by “sources of error”.*

- “Figure 3: Could the authors please somehow increase the spacing between the black and gray bars? In its current form the plots look very blurry/3D-ish due to the close proximity of the two bars.”

***Answer:** Done.*

2. Answers to the comments by Reviewer 1

Basic reporting

“Obesity and overweight are important risk factors for morbidity and mortality. Therefore, the reliable measurement of the anthropometric measures is crucial to determine the risk of chronic diseases such as the metabolic syndrome. However, the accurate measurement of anthropometric markers in population based epidemiological studies is challenging due to a high inter- and intra-observer variability of the manually derived measures. 3D body scanning technology promises to measure accurately a large number of body measures within a few seconds. The present paper from Koepke et.al. aims to compare the scanning and the manual anthropometric measurement techniques based on five selected body measurements. Overall, the paper is very well written and easy to follow. The study adds valuable data to the still small number of validation studies comparing the scan technique with manual measurements. All relevant studies have been taken into account in the introduction section as well as in the discussion section. The conclusions drawn from the results are mostly traceable and coherent. Tables and figures are presented in an appropriate manner.”

- “The words “cross-sectional study” should be replaced by “validation study” in the title.”

***Answer:** Done.*

Experimental design

- “The main limitation is the selection of the study participants, restricted to young men aged 18 to 38 years. Furthermore, there were no obese subjects included in the study. Our (still unpublished) analysis showed greater differences between manually derived anthropometric measures in women compared with men. Furthermore, our data indicates greater differences in obese subjects (with BMI greater or equal 30 kg/m²) compared with subjects with a BMI lower than 30 kg/m². On the one hand, a low variability might facilitate the comparison of the two techniques. On the other hand, in epidemiological studies we see a wide variability of body shapes. Therefore, to make the results more representative validation studies should include samples with greater heterogeneity. This should be further addressed in the discussion section.”

***Answer:** Thank you very much for the comment and for sharing your preliminary results, which are of great interest to us. We enhanced the corresponding part of the limitations paragraph in the discussion section in this direction.*

- “Can the authors explain the selection of the selected body scanner measures? For instance, “high waist girth” seems to be a more precise automatic measure for waist circumference than “waist girth”. Furthermore, chest circumference is an uncommon marker for general or abdominal obesity in epidemiological studies. The authors should explain more detailed the selection of the studied measures.”

Answer: Thank you for the comment. We agree that such a rationale was missing in the previous version of the manuscript. To our state of knowledge, there do not yet exist widely accepted guidelines but rather “hands-on” experiences only, which automatic scanner measurements correspond best with the selected traditional anthropometric measurements. Thank you for suggesting “high waist girth”, we will certainly test that in following studies! In general, we chose those scan measurements whose definition of the measurement reference points in the manuals of the manufacturer corresponded best with the WHO guidelines of the manual measurements. Because the difference between the automatic scan measurement “waist girth” and traditionally measured waist circumference according to WHO guidelines in our data was relatively small (1.17cm by average) and agreement between the two techniques was relatively high we did not yet test alternative scan measurements. Overall, having abdominal fat and future studies in mind, we are particularly interested in circumference measurements from the trunk area, that’s why we also included rather unusual measurements like buttock and chest circumference. A combination of these (and maybe other) measurements could contribute to display the shape of the trunk. We added a corresponding sub-sentence briefly outlining this rationale to the scan measurement paragraph in the data and methods section.

Validity of the findings

- “Could you exclude a bias for the comparison of the two manually derived measurements? I would expect that the examiner remembers the afore measured value so the subsequent measurement could be biased.”

Answer: Thank you for the comment. We apologise for the confusion and our unclear wording. Each proband was manually measured by two different(!) trained examiners. We complemented and specified the description of the manual measurements in this sense.

- “The findings regarding the association of health determinants and anthropometric measures are not very meaningful due to the limited information on the health status of the study participants (threats of confounding) and the selected sample (threats of bias). Therefore, I recommend omitting this analysis in the present publication.”

Answer: Thank you very much for your recommendation. We agree on the limited explanatory power of the ‘numbers of visits to a physician’ and the ‘weekly hours of sports’ variables in our data (presumably due to the rather homogenous sample composition). However, explaining associations between health determinants and anthropometric measures was NOT the goal of this step in our analysis (as already outlined in the limitations section in the discussion). In fact, we simply wanted to test if the two techniques lead to similar or differing results (coefficients) when used in regressions (regardless if we find a significant association or not). To our opinion, this helps to assess the usefulness of the two techniques and has not been done in other validation studies. As this step of our analysis remains a valuable piece in our line of argumentation we would like to keep it in the manuscript. We added a sub-sentence to the statistical methods section clarifying our aim of the regression analysis.

3. Answers to the comments by Reviewer 2

Basic reporting

- “1. Table 1: Physician number of visit non of interest for the study, add height and BMI”

Answer: Thank you for the comment. We respectfully disagree with the reviewer. Height and BMI are not reported in Table 1 but in fact in Tables 2 and 3 because – unlike weight – they differ depending on the applied method (traditional anthropometrics vs. scans). However, we added a sentence in brackets to the legend of Table 1 saying that the results of height and BMI are reported in Tables 2 and 3. The ‘numbers of visits to a physician’ variable is important to the study because of two reasons: A) It gives a very crude information about the general state of health of our study probands (following a comment by Reviewer 3. B); we use it as one of the explanatory categorical variables in the regression analysis. As argued in a reply to Reviewer 1, we agree on the limited explanatory power of the ‘numbers of visits to a physician’ (and the ‘weekly hours of sports’) variables in our data (presumably due to the homogenous sample composition), but explaining associations between health determinants and anthropometric measures was NOT the goal of this step in our analysis (as mentioned in the limitation paragraph in the discussion section). In fact, we simply wanted to test if the two techniques lead to similar or differing results when used in regressions

(regardless if we find a significant association or not). In this line (comparing the two techniques), the 'numbers of visits to a physician' variable is as important for our argumentation as the other variables reported in Table 1.

- “2. Specify abbreviations (perc= %?)”

Answer: Done.

- “3. Table 2 on manual measurements) : take out height”

Answer: Thank you very much for the comment. We respectfully disagree with the Reviewer. As outlined in our reply to the first comment, we would like to keep the reporting of manual and scanned height in Table 2, because – unlike weight in Table 1 – height differs depending on the applied method (traditional anthropometrics vs. scans).

- “4. Table 4: take out obesity parameters Waist > 102, BMI > 30 (not of interest with your data)”

Answer: Thank you for the comment. Even though we agree that we do not have probands falling in these obesity categories, we think that it is nevertheless of importance to report these numbers in Table 4 in order to underline that the reclassification issue does not affect these obese categories but rather the normal weight and overweight categories only.

Experimental design

- “tape measurements (body circumferences) and height should be done 3 times.”

Answer: Thank you for the comment. We generally agree, of course, especially when it comes to highly volatile measures like blood pressure etc. Unfortunately, we cannot go back in time and do additional measurements on the presented study population. We will proceed accordingly in future studies. In addition, several other validation studies (e.g., Jaeschke et al. 2015 and Ng et al. 2016) follow the same modus operandi of two repeated manual tape measurements (and scans).

- “any comment about weight measurement”

Answer: Thank you for the comment. We added more information to the corresponding sentence in the data and methods section.

- “buttock circumference is of no interest for clinical outcomes. I'd like to know why they chose it.”

Answer: Thank you for your comment. Circumference measurements of the hip area are generally used in combination with waist circumference to calculate indices such as waist-to-hip ratio, which target on abdominal obesity. Since it was not entirely clear from the beginning, which one of the hip circumferences provided by the scanner corresponds best to the hip measurement used in traditional anthropometrics in terms of comparable measurement points, we included two different circumferences from the hip area. Because it is our aim to focus on the shape of the trunk area in general in future studies (again with abdominal fat in mind), we also included bust circumference. We added a sub-sentence outlining this rationale to the scan measurement paragraph of the data and methods section.

Validity of the findings

- “1. Concern: is that type of 3D scan validated for body composition? (i couldn't find anything about it)”

Answer: Thank you for the comment. We agree on this gap and added a corresponding sentence to the introduction section which read as follows: “There are even some studies showing that 3-D body scan results correlate with total and regional fat mass (Wang et al., 2006; Lee et al., 2015; Ng et al., 2016), but further evidence is needed as to whether they can produce reliable predictions when compared to DEXA or MRI standards.”

- “2. tape measurement are not influenced by the time of the day (line 445)”

Answer: *Thank you very much for the comment. We apologise for the misunderstanding. What we meant by “anthropometric measurements are also influenced by the time of the day” is that an individual’s height and other body dimensions can change over the course of one day (e.g., taller in the morning than in the evening). Because this fact could affect the measurement results (in particular the difference between the technique outcomes) when the temporal distance between tape measurements and the scans of one single proband is too large, we ensured that all measurements on one individual have been done within 20 minutes. To make our statement clearer we replaced “measurements” by “measures” and added an exemplarily sentence in brackets to the corresponding paragraph of the discussion.*

Comments for the author

- “I think it's a good idea as a study however, in order to have clinical meaning, I'd add comparison of normal to OW measurement regarding all parameters like in Olivares J, Wang J, Yu W, Pereg V, Weil R, Kovacs B, Gallagher D, Pi-Sunyer FX. Comparisons of body volumes and dimensions using three-dimensional photonic scanning in adult Hispanic-Americans and Caucasian-Americans. J Diabetes Sci Technol. 2007 Nov;1(6):921-8.”

Answer: *Thank you very much for the suggestion. We fully agree and already have planned to do so and enhance the clinical meaning in future studies we are currently about to start. However, for this first validation step we were primarily interested in the comparison of the two techniques in terms of their accuracy and precision of simple trunk circumference measurements, which are partially also used for common overweight and obesity indices (such as BMI, WC, WHtR, WHR) in the clinical setting. However, we added Olivares et al. 2007 as a reference to the introduction.*

4. Answers to the comments by Reviewer 3

Basic reporting

“Overall format is adherent to policies. Below are minor comments.”

- “1. Table 2: Please add the units of precision?”

Answer: *We apologise for this omission and added “cm” where it was missing.*

- “2. Line 70: replace comma with semicolon (two independent clauses)”

Answer: *Done.*

- “3. Line 128: conjunction “and” after the semicolon is unnecessary here”

Answer: *Done.*

Experimental design

- “This is a fast moving field and there have been some recent articles that should be referenced, including BK Ng et al. “Clinical anthropometrics and body composition from 3D whole-body surface scans” and Lee JJ et al. “Prediction of android and gynoid body adiposity via a three-dimensional stereovision body imaging system and dual-energy X-ray absorptiometry.” The results here should be contrasted with these papers in terms of accuracy and precision.”

Answer: *Thank you very much for the comment. We agree and we are aware that both of these very recent papers were missing in the first version of our manuscript. We added them as references in a new paragraph on body composition validation in the introduction section (following a comment by Reviewer 2), and we compared our results to these studies in the discussion. However, since the main aim of both of these other studies was to validate 3D scans with body composition as assessed from MRI, the richness of details in reporting on differences between traditional anthropometrics and scanned measurements is rather thin.*

- “2. V.B.?! The comments about the use of the body volume estimates using Siri need to include caveates that body composition from total body volume is highly unstable and that small differences in body volume can create large errors on body composition.”

***Answer:** Please excuse but we might miss the link between your comment and our manuscript. We fully agree on the limitations of body composition estimates using Siri equations, but we do not directly or indirectly mention this point in our manuscript?*

- “3. A parametric test, such as an ANOVA, should be estimated to evaluate the precision of each of the measurement techniques. Lee JJ et al. shows techniques for comparisons.”

***Answer:** Because ANOVA and a simple t-test are equivalent for two groups we decided to stick to the paired t-test for two samples, which we already use to compare the two techniques against each other (see Table 3). The new results (non-significant differences between the two scans, partially significant differences between the two manual measurements) are reported in a new column in Table 2. We also added new (sub)sentences to the data/methods and the results sections.*

- “4. Table 3: The WHR correlation seems very so low. Please justify.”

***Answer:** Thank you for spotting this. We recalculated the correlation coefficient (and all results from Table 3). As it seems, there was a confusion of numbers. The correlation for WHR was 0.85 (and not 0.58). We deeply apologise for this mistake!*

- “5. Figure 2: Include how the buttocks are defined differently for SM and MM?”

***Answer:** Please kindly note that we already describe the difference in lines 406ff of our original manuscript: “Whereas the scanner measured the largest circumference around the buttock, the manual measurers measured the circumference on the mid-buttock position.” However, we added a similar sentence to the legend of Figure 2.*

- “6. Figure 3: Please explain how waist circumference varies by hours of sport does not add much value to the main purpose of this article, which is to compare two measurement techniques.”

***Answer:** As outlined above (replies to Reviewer 1 and 2), we agree on the limited explanatory power of the ‘numbers of visits to a physician’ and the ‘weekly hours of sports’ variables in our data (presumably due to the homogenous sample composition). However, explaining associations between health determinants and anthropometric measures was NOT the goal of this step in our analysis (as already outlined in the limitations section in the discussion). In fact, we simply wanted to test if the two techniques lead to similar or differing results (coefficients) when used in regressions (regardless if we find a significant association or not). To our opinion, this helps to assess the usefulness of the two techniques and has not been done in other validation studies. As this step of our analysis remains a valuable piece in our line of argumentation we would like to keep it in the manuscript. In turn, we added a sub-sentence to the statistical methods section clarifying our aim of the regression analysis.*

- “7. Appendix Figure 2: Please explain why the kernel density plots appear so differently in the buttocks region?”

***Answer:** Thank you for spotting this. In general, the differences between MM1 (manual measurement 1) and MM2 are larger than between the two scan measurements in all(!) circumferences. This is also reflected in the more differing appearance of all(!) MM1 vs. MM2 circumference kernel density plots in Appendix Figure 2, indicating towards a generally higher inter-observer error when measuring the circumferences manually. In the case of MM1 vs MM2 buttock circumference the difference may be slightly more pronounced because the challenging placement of the tape (according to the protocol at the mid-buttock position) could have caused even larger inter-observer errors. We added a corresponding sentence to the second paragraph of the discussion.*

Validity of the findings

- “The population is incompletely described. No mention is given to male/female ratio, where this sample came from, or how they were recruited? Were they a healthy cohort? Unknown health status? Please include more detail.”

Answer: Thank you for the comment. We respectfully point the reviewer to the paragraph on the study sample in the data and methods section. There, we describe the study population regarding sex distribution (only males), age, physical activity level, and number of visits to a physician during the last year (as a crude proxy for general health). We summarise all available information in Table 1. Moreover, we also say that the study sample consists of young adult males, voluntarily recruited via public advertisement in the university environment. Unfortunately, our questionnaire did not include more specific questions, e.g. on socio-economic background (level of education, occupation, income) or health status. We assume that most of the study probands were students, but we cannot back up this statements with numbers. As we mention in the manuscript, the number of participants with three or more visits to a physician during the last year was rather low (15.5%), which indicates that most of the study probands were in good general health. We added more information in this direction to the study sample paragraph.

- “2. Please provide what quality assurance was performed on the scanner to insure accuracy over the course of the study.”

Answer: Thank you for the comment. We agree and added a sentence to the corresponding paragraph on the scan measurements in the data collection section saying that the scanner was calibrated once at the beginning of every measurement day following official protocols of the manufacturer.

Comments for the author

“This manuscript evaluated the accuracy and precision of a 3D laser-based scan (SM) against manually-derived (MM) anthropometric measures. The motivation is to add to the collective knowledge on this relatively new field of optic-based scanning of anthropometric measures as indicators of health. The study included 123 young male participants, and their data were collected in February 2013. Each participant underwent 3 tests: a questionnaire, a 3D laser scan, and a manual measurement of anthropometric variables defined by the World Health Organization. The study showed that most measures were precise for both SM and MM (except for the chest, waist, and buttock for MM). The study also showed that the two techniques were highly correlated and, thus as expected, similar values for linear regression.”

Technical Changes

- “References: In the reference section, please provide the full author name lists for any references with 'et al.' including this reference: “Di Cesare M, Bentham J, Stevens GA, Rühli FJ, Staub K, Faeh D, Gutzwiller F, et al.””

Answer: This publication is co-authored by over 700 scientists. We decided to stick to Pubmed (<https://www.ncbi.nlm.nih.gov/pubmed/27115820>) and listed the NCD Risk Factor Collaboration (NCD-RisC) as the “single author” of this publication.

- “Keywords: Please remove the Keywords from your manuscript and make sure they are included in the metadata instead.”

Answer: Done.

- “Author Contributions: Please remove all author contributions information from the source file manuscript and make sure it is included in your Authorship Statement instead.”

Answer: Done.

- “Tables: In addition to any tables embedded directly in your text manuscript, please also upload the tables in separate Word documents here <<https://peerj.com/manuscripts/12914/files>> as these will be used in production. [note: Tables should not be a .jpg or .pdf image of a table pasted into the Word document.] The file should be named using the table number: Table1.doc, Table2.doc.”

Answer: Done.

- “Figures: 1) Please use numbers to name your files, example: Fig1.eps, Fig2.png. 2) Each figure with multiple parts should label each part alphabetically (e.g. A, B, C) and all parts should be submitted together in one file. Ex: Figs 1A and 1B should be one figure grouping the parts either next to each other or one on top of the other and only labeled “A” and “B” on the respective figure parts. 3) In addition to providing figures embedded in the manuscript, please upload your higher resolution (at least 900 by 900 pixels) figures in either EPS, PNG, JPG (photographs only) or PDF (vector PDF's only) as primary files here <<https://peerj.com/manuscripts/12914/files>> as these will be needed at production. Note: You have chosen to submit the reviewing manuscript as a 'single PDF' and so these higher resolution figures won't be merged with that document, just used at production.”

Answer: Done. However, we did not add further sub-labels in figures 2 and 3 as well as in the supplementary figures, because we worry that it would cause graphical overload (alternatively, replacing the already incorporated sub-titles naming the measurements under consideration in each column would make the figures less comprehensible). But we are happy to include additional sub-labels if the editors insist to do so.

- “Manuscript Source File: 1) Please provide the clean unmarked source file (e.g. .DOCX, .DOC, .ODT) with no tracked changes shown, all tracked changes accepted and tracked changes turned off. 2) Please do continue to include low res files embedded in the manuscript and upload the manuscript file here: <https://peerj.com/manuscripts/12914/files/>. 3) If you uploaded a PDF because of formatting problems, please provide the .docx source file as a Supplemental File and we will mark it as the correct file type as necessary if the manuscript is accepted.”

Answer: Done.

- “Authorship: Authors Maciej Henneberg and Frank J Rühli still need to confirm their co-authorship using the email they received from PeerJ. Please ask them to check their spam folders.”

Answer: Done.