

## PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (<http://bmjopen.bmj.com/site/about/resources/checklist.pdf>) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

### ARTICLE DETAILS

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| <b>TITLE (PROVISIONAL)</b> | Comparison of Anthropometric Indices for Predicting the Risk of Metabolic Syndrome and Its Components in Chinese Adults: A Prospective, Longitudinal Study       |
| <b>AUTHORS</b>             | Wang, Haoyu; Liu, Aihua; Zhao, Tong; Gong, Xun; Pang, Tianxiao; Zhou, Yingying; Xiao, Yue; Yan, Yumeng; Fan, Chenling; Teng, Weiping; Lai, Yaxin; Shan, Zhongyan |

### VERSION 1 - REVIEW

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| <b>REVIEWER</b>        | Dr. Nima Motamed<br>Department of social medicine, Zanjan university of medical sciences, Iran |
| <b>REVIEW RETURNED</b> | 13-Feb-2017  |

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| <b>GENERAL COMMENTS</b> | <p>The authors conducted a prospective study in which the predictive ability of many indices was evaluated for MetS and its components. This study is interesting. A few data of prospective studies is usually available in developing or even developed countries. However, I have a few suggestions to improve the study. I recommend that the authors provide the age's range of participants in methods of abstract. It is suggested the authors provide, at least, a report of AUC values for BMI and AVI in results of abstract. I propose that the sampling was explained in details. A more explanation is required for ROC analysis (predictors, outcomes, methods)</p> <p>The IDF definition of MetS was considered the outcome in this study. Based on this definition, a high value of WC is a prerequisite for diagnosis of MetS. Consequently, the estimations of predictive capabilities of WC can be suffered from bias. The authors can consider the, at least, two other components of MetS (except for WC) as outcome. Authors can also consider it as a limitation of study.</p> |
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| <b>REVIEWER</b>        | CHEN Yajun<br>Sun Yat-sen University, China |
| <b>REVIEW RETURNED</b> | 22-Feb-2017                                 |

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| <b>GENERAL COMMENTS</b> | This longitudinal prospective study aimed to distinguish the ability of anthropometric indices to assess the risk of metabolic syndrome (MetS) at the time of cross-section analysis and during a 4.5-year follow-up. This is the first study to systematically report the different abilities of anthropometric indices in diagnosing or predicting metabolic syndrome. We know MetS is considered as a cluster of |
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|  | <p>risk factors for cardiovascular morbidity and mortality, involving more than 50% of adults based on the present study, and the authors try to find the best anthropometric indices to predict Mets. The study concluded that VAI is the best index for diagnosis of MetS in this cross-section. But the authors said that although no obvious advantages were observed for WC, BMI and AVI are superior to the other anthropometric indices for predicting MetS in males and females, respectively. However, considering the simplicity and wide utilization, WC remains the more practical discriminator for MetS. But I do not know why they could get this conclusion from their own results. I also wonder the significance of this study. Is it necessary that we also work hard to find the best index for diagnosis of MetS nowadays? So the authors should try to make it clear to the readers.</p> <p>Although the study is well-written, there is still some errors throughout the manuscript. Please try to check your paper before submission.</p> <ol style="list-style-type: none"> <li>1. Ref. 19. uncompleted.</li> <li>2. Ref. 22. uncompleted</li> <li>3. Page 6. Line 97. 4. No content.</li> </ol> |
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| <b>REVIEWER</b>        | Miquel Bennasar-Veny<br>Balearic Islands University<br>Spain |
| <b>REVIEW RETURNED</b> | 29-Apr-2017  |

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| <b>GENERAL COMMENTS</b> | <p>This is an interesting paper from Prof. Lai and co-workers that evaluate the ability of anthropometric indices to assess the risk of the MetS at the time of cross-section analysis and during a 4.5-year follow-up in middle-aged and elderly subjects in northeast China (n= 379). The study indicates the different abilities of anthropometric indices in diagnosing or predicting MetS with IDF criteria.</p> <ul style="list-style-type: none"> <li>- The main questions raised in this work are pertinent and well defined.</li> <li>- This is an interesting work and well-written manuscript, although the study population only belongs to a particular region. These points limit the interest of the paper.</li> </ul> <p>I think that some changes are still needed. Comments:</p> <ul style="list-style-type: none"> <li>- Strengths and limitations sections should be improved.</li> <li>- WHtR, WHR and WC indexes may be better candidates for use in clinical practice and research to evaluate both metabolic and cardiovascular risk. The authors should evaluate the possibility of including WHtR index</li> <li>- 22 bibliographical citations are insufficient for a paper like this. In addition, authors should reconsider the possibility of including a greater number of bibliographic sources in the discussion section. Revise citations format. Some citations should be replaced by other more recent references.</li> <li>- The number of decimals should be agreed.</li> <li>- Formulas in page 8 should be changed in another format.</li> <li>- In page 11 line 11 revise "(" and "]" format.</li> </ul> <p>The writing can be improved, but just in terms of editing for the English language. Overall, I believe it is well written. The entire paper has been carefully constructed.</p> |
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| <b>REVIEWER</b>        | Fernanda de Carvalho Vidigal<br>Universidade Federal de Alfenas - Brazil |
| <b>REVIEW RETURNED</b> | 04-May-2017  |

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| <b>GENERAL COMMENTS</b> | <p>The manuscript entitled "Comparison of Anthropometric Indices for Predicting the Risk of Metabolic Syndrome and Its Components in Chinese Adults: A Prospective Study" aimed to distinguish the ability of anthropometric indices to assess the risk of metabolic syndrome (MetS) at the time of cross-section analysis and during a 4.5-year follow-up. The question that the authors deal with is an interesting topic, in spite that it has been previously studied elsewhere, including in the same country.</p> <p>Minor Essential Revisions:</p> <p><b>Abstract:</b><br/>In the subsection "Setting, participants and outcome measures": Should include the age of the participants.<br/>In the line 76, page 5, "...according to the criteria of the International Diabetes Federation". Please, include the year of the criteria used.<br/>In the line 76, page 5, replace "Receiver operating curve (ROC)" by "Receiver Operating Characteristic (ROC) curve".<br/>Line 81, page 5, after the abbreviation "ROC", please include the word "curve".</p> <p><b>Background:</b><br/>Line 113, page 7, verify the anthropometric indice and the respective abbreviation, because there is an error in "body adiposity index (BRI)". Verify if the correct would be "body adiposity index (BAI)" or "body roundness index (BRI)".</p> <p>Lines 124 and 125, page 7, please, complete the objectives. Do you want to compare the predictive ability of anthropometric indices with what?</p> <p><b>Data Measurement and Collection:</b><br/>Line 150, page 8, please include the reference of the standard methods used.</p> <p><b>Metabolic Syndrome Definition:</b><br/>Line 157, page 9, "...based on the International Diabetes Federation criteria...". Please, include the year of the criteria used.</p> <p><b>Calculations:</b><br/>Please, detail better. Include the references used for each formula and include the unit of measure of the variables used to calculate the formulas.</p> <p>I suggest including in the analysis (calculations, results and discussion) the anthropometric indice "waist-to-height ratio (WhtR)".</p> <p><b>Results:</b><br/>Line 194, page 11, include the word "years" after 49.5 and 47.0.<br/>Line 196, page 11, standardize the acronym used for fasting plasma insulin (FIN or FINS?).</p> <p>In the subsection "AUCs of the anthropometric indices for predicting MetS components during follow-up", page 13, Improve the writing of results. For example, avoid describing the data "all the indices" and</p> |
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|  | <p>then "except" (lines 242 and 243) or "none of the anthropometric indices" and "except" (245 and 246).</p> <p>Discussion:<br/>Discuss the data of plasma glucose 2 hours after a glucose load (2 h PG), fasting plasma insulin (FINS) and the data of magnetic resonance imaging scans in order to justify the inclusion of these analyzes in the study.</p> <p>Abbreviations:<br/>Line 319, page 16, replace "ROC: Receiver operating curve" by "Receiver Operating Characteristic (ROC) curve".</p> <p>Tables and Figure:<br/>Put each table and figure on a separate page.<br/>Include below each table the meaning of the abbreviations and the statistical test used.<br/>In the Table 3, page 26, explain better the note "a, vs WC, P&lt;0.05."<br/>Table 5, page 29, I suggest replacing the title "Comparison of AUCs for anthropometric indices in predicting MetS and its components in males" by "Comparison of AUCs for anthropometric indices in predicting MetS components in males".</p> <p>Table 6, page 31, I suggest replacing the title "Comparison of AUCs for anthropometric indices in predicting MetS and its components in females" by "Comparison of AUCs for anthropometric indices in predicting MetS components in females".</p> <p>Level of interest: An article of interest.</p> <p>Quality of written English: Acceptable.</p> |
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### VERSION 1 – AUTHOR RESPONSE

Response to comments by Reviewer#1

1. I recommend that the authors provide the age's range of participants in methods of abstract.

Response: As a response to the reviewer's comment, we have shown the age's range of participants in methods of Abstract. Thank you for your advice.

2. It is suggested the authors provide, at least, a report of AUC values for BMI and AVI in results of abstract.

Response: Thanks a lot. We have added these information in the Abstract.

3. I propose that the sampling was explained in details. A more explanation is required for ROC analysis (predictors, outcomes, methods)

Response: Thanks for suggestion. We have modified our sampling explanation in the Method.

4. The IDF definition of MetS was considered the outcome in this study. Based on this definition, a high value of WC is a prerequisite for diagnosis of MetS. Consequently, the estimations of predictive capabilities of WC can be suffered from bias. The authors can consider the, at least, two other components of MetS (except for WC) as outcome. Authors can also consider it as a limitation of study.

Response:

Thank you for your advice again. The IDF 2009 criterion was used in this study. For the MetS was defined as the individual meets any three of the five components, waist circumference had limited effect on the results. However, as you said, different MetS definitions do have an impact on the

outcome. Therefore, we proposed this point as a limitation in the Discussion section.

Response to comments by Reviewer#2

1. The study concluded that VAI is the best index for diagnosis of MetS in this cross-section. But the authors said that although no obvious advantages were observed for WC, BMI and AVI are superior to the other anthropometric indices for predicting MetS in males and females, respectively. However, considering the simplicity and wide utilization, WC remains the more practical discriminator for MetS. But I do not know why they could get this conclusion from their own results. I also wonder the significance of this study. Is it necessary that we also work hard to find the best index for diagnosis of MetS nowadays? So the authors should try to make it clear to the readers.

Response: Thanks for your suggestion. We have thought the question seriously and hope our answer will satisfy you. There is accumulating evidence that increased abdominal visceral fat is the most important risk factors for MetS, and the area of visceral fat measured by MRI scan has been considered the best indicator for abdominal adipose tissue. However, as we known, it is not realistic to conduct abdominal obesity screen by MRI in clinic. Therefore, many scholars have tried to find a surrogate index for a long time. And it is best to be simple, convenient and, especially, non-invasive. At the first, our study suggested that BMI and AVI had higher AUCs than WC, but the difference between them and WC was not significant. Secondly, WC can get the readings only through simple measurement, but the others require relatively complex mathematical calculations, and even biochemical tests such as VAI. Without the help of computing devices, we are afraid that it is hard to get results in time, and limited themselves to be applied to epidemiological or clinical setting. Finally, previous study has established a specific waist circumference reference value for Chinese people, and clinical application is also widely. Hence, there is insufficient evidence to replace the WC with novel anthropometric indices.

Thanks for your advice again, and we have added these context to our manuscript.

2. Please try to check your paper before submission,

a. Ref. 19. uncompleted.

b. Ref. 22. uncompleted

c. Page 6. Line 97. 4. No content.

Response: We are sorry for these mistakes and have modified them. Thanks for your suggestions.

Response to comments by Reviewer#3

1. Strengths and limitations sections should be improved.

The main questions raised in this work are pertinent and well defined. This is an interesting work and well-written manuscript, although the study population only belongs to a particular region. These points limit the interest of the paper.

Response: Thanks for your advice. We have re-written this section.

2. WHtR, WHR and WC indexes may be better candidates for use in clinical practice and research to evaluate both metabolic and cardiovascular risk. The authors should evaluate the possibility of including WHtR index

Response: Thank you for your suggestion. We have seriously thought about it. As we known, WHtR and BRI were calculated according to the following formula:

$WHtR = WC/Height$ ,

$BRI = 364.2 - 365.5 \times [1 - (WC/2\pi)^2 / (0.5 \times Height)]^{0.5}$ .

The simplified formula of BRI can be obtained as following,

$BRI = 364.2 - 365.5 \times [1 - \pi \times 2 \times (WC/Height)^2]^{0.5}$

$= 364.2 - 365.5 \times [1 - \pi \times 2 \times (WHtR)^2]^{0.5}$

$= 364.2 - (365.5/\pi) \times (\pi^2 - WHtR^2)^{0.5}$

At this point, we can draw a clear conclusion as WHtR and BRI have the same mathematical

meaning. In fact, we also calculated WHtR, and took it into all the analyses. WHtR did get the same results as BRI. Therefore, we believe that the results of BRI in this article are applicable equally for WHtR, no matter mathematically or statistically. In the Discussion section, the additional explanation was added. Thanks again.

3. 22 bibliographical citations are insufficient for a paper like this. In addition, authors should reconsider the possibility of including a greater number of bibliographic sources in the discussion section. Revise citations format. Some citations should be replaced by other more recent references.  
Response: Thank you. We have modified and updated the references according your advice.

4. The number of decimals should be agreed. Formulas in page 8 should be changed in another format. In page 11 line 11 revise (“ and ”) format.  
Response: We have modified these mistakes. Thank you.

5. The writing can be improved, but just in terms of editing for the English language.  
Response: Thank you again. We have re-edited our manuscript.

#### Response to comments by Reviewer#4

##### 1. Abstract:

In the subsection “Setting, participants and outcome measures”: Should include the age of the participants.

In the line 76, page 5, “...according to the criteria of the International Diabetes Federation”. Please, include the year of the criteria used.

In the line 76, page 5, replace “Receiver operating curve (ROC)” by “Receiver Operating Characteristic (ROC) curve”.

Line 81, page 5, after the abbreviation “ROC”, please include the word “curve”.

Response: Thanks for your suggestions. We have modified our Abstract accordingly.

##### 2. Background:

Line 113, page 7, verify the anthropometric indices and the respective abbreviation, because there is an error in “body adiposity index (BRI)”. Verify if the correct would be “body adiposity index (BAI)” or “body roundness index (BRI)”.

Lines 124 and 125, page 7, please, complete the objectives. Do you want to compare the predictive ability of anthropometric indices with what?

Response: We are sorry for these mistakes, and have corrected them. Thanks a lot.

##### 3. Data Measurement and Collection:

Line 150, page 8, please include the reference of the standard methods used.

Response: We have added the information.

##### 4. Metabolic Syndrome Definition:

Line 157, page 9, “...based on the International Diabetes Federation criteria...”. Please, include the year of the criteria used.

Response: Thank you again. We have corrected the mistake.

##### 5. Calculations:

Please, detail better. Include the references used for each formula and include the unit of measure of the variables used to calculate the formulas.

Response: Thanks a lot. We have updated the references for each formula, and added the unit of these variables.

6. I suggest including in the analysis (calculations, results and discussion) the anthropometric indices

“waist-to-height ratio (WHtR)”.

Response: Thank you for your suggestion. We have seriously thought about it. As we known, WHtR and BRI were calculated according to the following formula:

$WHtR = WC/Height$ ,

$BRI = 364.2 - 365.5 \times [1 - (WC/2\pi)^2 / (0.5 \times Height)]^{0.5}$ .

The simplified formula of BRI can be obtained as following,

$BRI = 364.2 - 365.5 \times [1 - \pi^{-2} \times (WC/Height)^2]^{0.5}$

$= 364.2 - 365.5 \times [1 - \pi^{-2} \times (WHtR)^2]^{0.5}$

$= 364.2 - (365.5/\pi) \times (\pi^2 - WHtR^2)^{0.5}$

At this point, we can draw a clear conclusion as WHtR and BRI have the same mathematical meaning. In fact, we also calculated WHtR, and took it into all the analyses. WHtR did get the same results as BRI. Therefore, we believe that the results of BRI in this article are applicable equally for WHtR, no matter mathematically or statistically. In the Discussion section, the additional explanation was added. Thanks again.

#### 7. Results:

Line 194, page 11, include the word “years” after 49.5 and 47.0.

Line 196, page 11, standardize the acronym used for fasting plasma insulin (FIN or FINS?).

In the subsection “AUCs of the anthropometric indices for predicting MetS components during follow-up”, page 13, Improve the writing of results. For example, avoid describing the data “all the indices” and then “except” (lines 242 and 243) or “none of the anthropometric indices” and “except” (245 and 246).

Response: Thanks a lot. We have modified our manuscript accordingly.

#### 8. Discussion:

Discuss the data of plasma glucose 2 hours after a glucose load (2hPG), fasting plasma insulin (FINS) and the data of magnetic resonance imaging scans in order to justify the inclusion of these analyzes in the study.

Response: Thanks. We have added these results in the Discussion accordingly.

#### 9. Abbreviations:

Line 319, page 16, replace “ROC: Receiver operating curve” by “Receiver Operating Characteristic (ROC) curve”.

Response: We have corrected this mistake. Thanks.

#### 10. Tables and Figure:

Put each table and figure on a separate page.

Include below each table the meaning of the abbreviations and the statistical test used.

In the Table 3, page 26, explain better the note “a, vs WC, P<0.05.”

Table 5, page 29, I suggest replacing the title “Comparison of AUCs for anthropometric indices in predicting MetS and its components in males” by “Comparison of AUCs for anthropometric indices in predicting MetS components in males”.

Table 6, page 31, I suggest replacing the title “Comparison of AUCs for anthropometric indices in predicting MetS and its components in females” by “Comparison of AUCs for anthropometric indices in predicting MetS components in females”.

Response: Thanks for your suggestions, we have modified our manuscript accordingly.

Once again, thank you for your interest in our work and for the valuable suggestions. We hope that you will now find the manuscript acceptable for publication in BMJ Open.

## VERSION 2 – REVIEW

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| <b>REVIEWER</b>        | Nima Motamed<br>Zanjan university of medical sciences, Iran |
| <b>REVIEW RETURNED</b> | 04-Jun-2017   |

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| <b>GENERAL COMMENTS</b> | The authors convincingly answered to my comments<br>It seems that this manuscript can be accepted in this status |
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| <b>REVIEWER</b>        | Fernanda de Carvalho Vidigal<br>Universidade Federal de Alfenas - Brazil |
| <b>REVIEW RETURNED</b> | 26-Jun-2017  |

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| <b>GENERAL COMMENTS</b> | <p>The authors carefully revised the manuscript accordingly both editor's and reviewers' questions and suggestions.</p> <p>To improve the quality of the manuscript I still think that the authors should review a better way to demonstrate clearly the formulas in the subsection "Calculations" of the section "Methods".</p> <p>For example:</p> <p>BMI = weight (kg)/ height 2 (m)</p> <p>WHR = WC (cm)/ HC (cm)</p> |
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## VERSION 2 – AUTHOR RESPONSE

1. To improve the quality of the manuscript I still think that the authors should review a better way to demonstrate clearly the formulas in the subsection "Calculations" of the section "Methods". For example:

BMI = weight (kg)/ height 2 (m)

WHR = WC (cm)/ HC (cm)

Reply: Thanks for your suggestion. Based on your examples, we have corrected our demonstration of the formulas in the section of Methods.

Once again, thank you for your interest in our study. We hope that our manuscript can be acceptable for publication in BMJ Open.