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

TITLE (PROVISIONAL)	The assessment of adult body composition using bioelectrical impedance: comparison of researcher calculated to machine outputted values
AUTHORS	Franco-Villoria, Maria; Wright, Charlotte; McColl, John; Sherriff, Andrea; Pearce, Mark; Gateshead Millennium Study core team, Group

VERSION 1 - REVIEW

REVIEWER	Dr. D.Chathuranga Ranasinghe Allied Health Sciences Unit, Faculty of Medicine University of Colombo, Sri Lanka
REVIEW RETURNED	30-Jul-2015

GENERAL COMMENTS	**General comments** 1. The topic of the manuscript discuss about a timely needed area of interest in body composition analysis. 2. The authors have tried to derive a general equation/formula for measurement of TBW by using other published data. It is fundamental that these prediction equations developed in different studies are specific for those populations and assessment methods concerned. Predictive equation developed by Bell et al. who used a sample of both males and females is specific to that sample. Taking the constant/slope of that equation and develop a new equation later to be used with different population data and different BIA machine impedance values will have inevitable errors. This methodology have major concerns of scientific validity and statistical approach. 3. Further the values derived from this 'new equation' was compared with reference values of another population which had different body composition. The similarity mentioned between the groups has not been statistically proven. 4. Authors have not shown/should have shown that there is a statistically significant difference between machine generated values and the researcher generated values. Further that machine generated values are different to the reference values

	they have quoted. There is no evidence to say that the machine generated values are statistically different to the references values mentioned. 5. Methodology could have been justified if the estimate/new equation for BIA was derived from the investigated sample of female adults/GSM mothers. Then correlating with a gold standard measure of BIA assessment; as done by Bell. Then the 'developed new equation' could be used to generate an output that can be compared with the machine generated output. This will show whether the manufacturer generated formula has errors. This comparison would be more scientifically valid since the data generated are from the same population and using same methods. **Specific comments** **Title** 1. The title lack the descriptive ability of the content and the focus of the manuscript. The authors need to revise it to be more specific since the content described in the manuscript has limited generalisability. **Abstract** 2. The objectives, mention about enhancing the accuracy and usefulness of BIA. The abstract should conclude how these objectives are met. 3. Page 2, 10: Need to define the specific population as the formula would depend on that. 4. Page 2, 11: Need to specify which machine, here or at methods. 5. Methodology is not mentioned in the abstract. 6. Results should direct to achieve the proposed objectives. The reader needs to identify specifically how each objectives are met through the results.

	7. Page 2, 48-52: The conclusion could not be generalised since this study used only one brand of BIA machine and one method of BIA measurement (Leg to leg). 8. It is good to see the strengths and weaknesses are mentioned. **Introduction** 9. Page 4, 30-34: There are further developments in BIA measurement using whole body and 8 electrode techniques, where the manufacturers have tried to reduce the error. 10. Page 4, 35-37: Please give reference. 11. Page 4, 40-47: Impedance reflects resistance and also reactance. The electric current pass via ionised fluid in lean tissue. Please include references. 12. Page 4-5, Para 2: Further description of reasons for lack of precision and accuracy of BC research is justified since the paper mainly discus about overcoming them. There are contradictory statements in discussion to the first reason for lack of precision which the authors should be concerned about. Additionally, it is correctly mentioned that absolute lean and fat mass could not be expressed in isolation. But it does not only depend on height, but also weight, sex, age, disease/metabolic status etc. Authors have assumed that it is mainly the inaccuracies of the predictive formula where the error occurs. They should also explain how the method itself can cause errors depending on which type of machine used, number of electrodes and condition of the participants, which are the major concerns in BIA errors. Also acknowledge the reason why the formulas can't be generalised since they will depend on number of variables discussed in the literature. **Methods** 13. As previously mentioned in general comments, there are major concerns to be revisited in the development of the estimate, using published constants. And application of such formula to a new population referenced by a completely different sample with different body compositions. 14. It is worthy to explore the equations provided by the manufacturer for the BIA machine used here, since the machine

used by Jebb et al. by the same manufacturer has documented such a formula.

15. It is suggested the analytical methods including calculation of lean and fat residuals to be reviewed by an expert statistician.

Results

16. Page 8, 7: It would be much appropriate to use the word “female adults” than “young female adults” since majority of the sample is between 30-53 years.
17. Table 1: Please be kind enough to correct the following. The TBW values for Tanita generated data are not included. SI Units for BMI and impedance are not mentioned. Whether LM and TMW differences statistically significant?
18. Page 8, 27-34: It is suggested that another column, of machine generated values to be included to table 2, stratified by age to directly compare with GMC and historical data.

Discussion

19. Page 11 Para 1: After agreeing the difficulty of extrapolating formulas in different populations and methods, authors have gone in to compare the present sample with a historical sample in a different population. The BMI values of the 2 samples differ. GMS mothers’ mean BMI is in overweight category (> 25 kgm^2) and in Chumlea it is <25 kgm^2.So similarity discussed in lean mass itself is contradictory.
    It is also not possible to infer the difference if adiposity to secular trends in these 2 groups as these were not the same group of participants who were followed up over the period prospectively. But rather different samples from different countries in different time periods.
20. Page 11 Para 2: Resistivity Constant used which is from the study of Bell had an intercept for the equation, TBW=**0.65+**0.66 ($height^2$/impedance) .If the intercept is removed from the formula the prediction would be inaccurate. Even it is ‘simple’, the prediction will be inaccurate only to use the resistivity constant (0.66) in the formula. Additionally the original equation from Bell was derived from a mix group of men and women. This again makes difficult to accurately use that constant in the equation to be used in this sample of only females.
21. Page 11, 50-52: The authors have generalised the modal to

	'most adult women' and further have predicted to be used with men, who have a different body composition to women. It is better the predictions and assumptions to be focused only to the investigated sample. 22. Page 12, 3-10: It would be appropriate to discuss why resistivity constant was different and in different types of samples. This will further elaborate why one type of constant could not be used to another different population. 23. Page 12, 14-19: Initially in introduction it is said that one reason for doubts about accuracy and precision in BIA is that prediction equations are trade secrets of the BIA Company. Then in discussion it is mentioned that such equations are made available by the company. The covariates are also mentioned. It is better the authors be cautious about these contradictory statements. 24. Page 12, 17-22: Since these variables are included in regression equations to maximize the predictive value, it is not accurate to discuss their contribution to the formula in isolation. Suggest expert statistical opinion on this. 25. Page 12, 31, 40: Please be concerned about the referencing in text (e.g. 'Jebb et al.'). It is mentioned as 'Jebb at all'.

REVIEWER	Aleman-Mateo H Research Center for Food and Developed, Mexico.
REVIEW RETURNED	30-Jul-2015

GENERAL COMMENTS	I read carefully the present paper; however, in their present form deserve to attend some important issues. Firstly. The title and objectives are very confused. From my understanding the main objective of the paper was: to assess body composition using a new composed equation based on BIA and compare the estimates with those provided by the manufacturer (BIA/Tanita). If I am right. These results are not novel for the body composition field, but the most important limitation is the lack of a gold standard method of body composition for this particular included sample. Using two BIA approaches is not possible to enhance the claimed accuracy state by the authors in first line of the abstract. In the abstract section there are some results beyond of the stated objectives, but also, this is not valid for validation purpose. i.e. Estimates of lean mass were similar to historical results. Introduction section. The information given for the authors does not lead to the main objectives, but most important issue is the lack of a scientific

	background that support the generation of new knowledges for the field of body composition and nutritional assessment through the body composition components. Please keep in mind, that when we are talking about the BIA not forget that it is a method based on the two compartment model. Therefore, we must refer to fat free mass instead of lean mass. Authors should review the concepts of BIA, i.e. impedance is composed of resistance and reactance. It should be very convenient to clarify why BIA is a doubly indirect method. All BIA information related is very confuse, last paragraph; pag. 6 Subjects and Methods BIA measured indirectly TBW, and there is an influence of the menstrual cycle on the hydration status, how this was controlled? The proposal equation to estimate body composition: LM= 0.66/0.732(height2/Z, assumed the hydration factor estimated from the cadaver analysis. However, most of the 50% of the women included in this study were overweight and had obesity, it is well known that obesity produced several body composition changes and these assumptions are not valid during aging and obesity. For example the hydration in obese people increases significantly. Therefore, this is another important limitation in this study, it deserve more attention in the absence of a gold standard method and valid for obese persons. The proposal of using lean mass and fat mass residual sounds interesting: however, in the absence of a gold standard method this is not a valid procedures, because the authors do not know if the estimated value is the true value. The Bland and Altman analysis is poorly explained in this section. In addition, authors before apply this analysis, a paired t test should be used to look if there are significant difference between two BIA methods. But the most important authors should run an analysis in order to test if the bias is significant or not. Results Table 1. The information is only descriptive, but I would like to see the results of the comparison by a t-test and to know if the values generated using published constants are different from Tanita generated data. Plots should provide statistical evidences about the bias, in other words, if the bias is significant or not, therefore to tests if there is agreement between methods. Discussion The discussion section is very limited and it does not support any scientific hypothesis and true limitation about BIA technique to assess human body composition.

REVIEWER	Fanny BUCKINX University of Liège, Belgium
REVIEW RETURNED	23-Sep-2015

GENERAL COMMENTS	General comment : this study aimed to explore and enhance the accuracy and usefulness of Bioelectrical Impedance Analysis. Overall, the results are interesting and original. Nevertheless, the presentation of the methodology should be better structured and the

	overall quality of English language should be improved. Specific comments : In the introduction, the authors state that hydrodensitometry is usually regarded as the gold standard. Another method for body composition assessment is often referenced (i.e. Dual energy X-rays absorptiometry (DXA)) and should be mentioned. In the introduction, the authors wrote: « electrical current through the body (50 kHz alternating current of 800 µA between electrodes) ». This is a single frequency device. Please, specify that multi-frequency bio-impedance analyzers also exist. In the introduction the authors wrote: « Although BIA is already widely used in practice and some body composition research, there remain doubts about its accuracy and precision. There are two possible reasons for this. … ». A third reason to mention is that prediction equations are device dependent, even among different types of BIA. The methods section should be divided into 2 paragraphs (with subheadings): one on the population and one on the data collection. This sentence « 1011 (81%) eligible mothers agreed to join the study » should be moved to the results section. « Information was collected on both children and parents and they have now been followed up to age nine years. ». This is unclear and should be rewritten. Please, specify the kind of information collected. « It was possible to collect impedance and growth data on 498 mothers (but only a tiny number of fathers) out of the 1011 who originally entered the study. ». Please, be coherent and specify the number of fathers. Moreover, this information should be moved to the results section. In fact, the first part of the results section should describe the study population. The authors state « Written informed consent was obtained from all subjects ». What about the children? Did the authors obtain parental consent? « The subjects were measured wearing light clothing and bare feet after being asked to empty their bladders ». Were the subjects fasting? In the results section, the author wrote « The GMS adults' data set consists of 498 young adult females mean (SD) age 36.3 (5.6) years. (age range 23.58 – 53.08 yr). Numbers should all be rounded to one decimal place. This comparison « Our results are compared with the results from the two historical papers in Table II 16;17, with the GMS mothers stratified by age to allow direct comparability. These revealed that results for LM were very similar, while the trends over time were to increasing weight, BMI and fat mass, except in the oldest mothers. » should be moved to the discussion section. In the discussion section, it would be interesting to compare the results obtained in the present study with results obtained with other types of BIA like the Tanita device for example.

	Limitations of this study should be discussed. The authors state « While the formulae used by BIA manufacturers may produce useable estimates of percentage fat… » Once more, it should be noted that each device has its own prediction equation. In table 1, results are expressed as median and IQR. The means and standard deviations should be added. In table 1, one can read that the %fat is 34.45. This seems quite high, especially knowing that BIA tends to underestimate body fat. This should be discussed in the appropriate section.

VERSION 1 – AUTHOR RESPONSE

Peer review report- DC Ranasinghe- 30.07.2015
General comments
1. The topic of the manuscript discuss about a timely needed area of interest in body composition analysis.
2. The authors have tried to derive a general equation/formula for measurement of TBW by using other published data. It is fundamental that these prediction equations developed in different studies are specific for those populations and assessment methods concerned. Predictive equation developed by Bell et al. who used a sample of both males and females is specific to that sample. Taking the constant/slope of that equation and develop a new equation later to be used with different population data and different BIA machine impedance values will have inevitable errors. This methodology have major concerns of scientific validity and statistical approach.
WE ARE GRATEFUL TO THE REVIEWERS FOR THEIR DETAILED ASSESSMENT OF OUR PAPER BUT FEEL THAT WE CAN REFUTE THE OBJECTIONS THEY HAVE TO OUR OVERALL APPROACH. PREDICTIVE EQUATIONS DEVELOPED IN ONE POPULATION HAVE TO BE APPLIED TO OTHER GROUPS, IF BIA IS TO BE USED FOR CLINICAL AND RESEARCH PURPOSES, SINCE IMPEDANCE ALONE HAS NO MEANING WITHOUT APPLYING THESE EQUATIONS. THE FIRST PURPOSE OF THIS PAPER WAS IDENTIFY THE BEST EXISTING CONSTANTS AND EXAMINE HOW THE RESULTS COMPARED TO HISTORIC GOLD STANDARD DATA. EMPIRICALLY THEY COMPARE WELL – SO IT ISN'T REASONABLE TO DISMISS THEM AS INVALID
3. Further the values derived from this 'new equation' was compared with reference values of another population which had different body composition. The similarity mentioned between the groups has not been statistically proven.
WE CHOSE THE PAPERS MENTIONED IN THE PAPER AS A REFERENCE, AS THE POPULATION CONSIDERED WAS SIMILAR TO OURS, I.E. WOMEN IN A SIMILAR AGE RANGE AND OF SIMILAR ETHNIC GROUP. IT IS NOT APPROPRIATE TO APPLY A FORMAL STATISTICAL TEST TO COMPARE DIFFERENT STUDIES USING DIFFERENT METHODOLOGIES, BUT WE HAVE ADDED A STATEMENT THAT THE GMS VALUES FOR YOUNGER WOMEN WERE AROUND 1 SDS HIGHER THAN FOR THE EARLIER COHORT FOR WEIGHT AND BMI AND %FAT, MAKING IT VERY UNLIKELY THAT THESE COULD HAVE OCCURRED BY CHANCE. IN CONTRAST THE LEAN MASS VARIED BY NO MORE THAN ¼ SD.
4. Authors have not shown/should have shown that there is a statistically significant difference between machine generated values and the researcher generated values. Further that machine generated values are different to the reference values they have quoted. There is no evidence to say that the machine generated values are statistically different to the references values mentioned.
WE HAVE NOW ADDED T-TEST DATA TO TABLE ONE – ALL THE DIFFERENCE WERE HIGHLY SIGNIFICANT (P,0.001).

5. Methodology could have been justified if the estimate/new equation for BIA was derived from the investigated sample of female adults/GSM mothers. Then correlating with a gold standard measure of BIA assessment; as done by Bell. Then the 'developed new equation' could be used to generate an output that can be compared with the machine generated output. This will show whether the manufacturer generated formula has errors. This comparison would be more scientifically valid since the data generated are from the same population and using same methods.
THERE IS NO NEED TO COMPARE TO AN EXTERNAL GOLD STANDARD IN ORDER TO COMPARE THE OUTPUT FROM TWO FORMULAE, WHEN BOTH ARE APPLIED TO THE SAME READING FROM THE SAME MACHINE
1. The title lack the descriptive ability of the content and the focus of the manuscript. The authors need to revise it to be more specific since the content described in the manuscript has limited generalisability.
WE ARE NOT CLEAR IN WHAT WAY THE REVIEW WOULD LIKE THE TITLE CHANGED
2. The objectives, mention about enhancing the accuracy and usefulness of BIA. The abstract should conclude how these objectives are met.
WE HAVE NOW OMITTED MENTION OF ACCURACY
3. Page 2, 10: Need to define the specific population as the formula would depend on that.
WE SPECIFY HOW OLD THEY ARE AND WHERE THEY LIVE AND HOW THEY WERE SAMPLED. WE ARE NOT CLEAR HOW WE CAN BE MORE SPECIFIC THAN THAT
Abstract 4. Page 2, 11: Need to specify which machine, here or at methods.
WE HAVE ADDED THIS
5. Methodology is not mentioned in the abstract.
WE FELT THE METHODS WERE ALREADY EFFECTIVELY DESCRIBED UNDER EACH OF THE SUBHEADINGS AS REQUIRED BY BMJ OPEN. HOWEVER WE HAVE NOW ADDED AN ADDITIONAL METHODS SECTION
6. Results should direct to achieve the proposed objectives. The reader needs to identify specifically how each objectives are met through the results.
THANK YOU: WE HAVE AMENDED TO MAKE THEM CORRESPOND BETTER
7. Page 2, 48-52: The conclusion could not be generalised since this study used only one brand of BIA machine and one method of BIA measurement (Leg to leg).
WE ARGUE THAT THIS CAN BE GENERALISED TO ANY LEG TO LEG MACHINE AS THE UNDERLYING PHYSICAL PRINCIPLES ARE THE SAME.
8. It is good to see the strengths and weaknesses are mentioned.
9. Page 4, 30-34: There are further developments in BIA measurement using whole body and 8 electrode techniques, where the manufacturers have tried to reduce the error.
WE HAVE ADDED MENTION OF THIS
10. Page 4, 35-37: Please give reference.
WE HAVE MOVED THE TEXT AROUND SO THAT THIS SITS WITH THE GENERAL BIA CITATION
11. Page 4, 40-47: Impedance reflects resistance and also reactance. The electric current pass via ionised fluid in lean tissue. Please include references.
WE HAVE ADDED A FURTHER CITATION TO KYLE HERE, AS THIS IS A GOOD, RECENT REVIEW
12. Page 4-5, Para 2: Further description of reasons for lack of precision and accuracy of BC research is justified since the paper mainly discus about overcoming them. There are contradictory statements in discussion to the first reason for lack of precision which the authors should be concerned about. Additionally, it is correctly mentioned that absolute lean and fat mass could not be expressed in isolation. But it does not only depend on height, but also weight, sex, age, disease/metabolic status etc.
IT IS IMPORTANT TO UNDERSTAND THE DISTINCTION BETWEEN THE ESSENTIAL MATHEMATICAL TRANSFORMATION NEED TO FIRST DERIVE TBW AND FROM THIS LEAN MASS, AND THE FACTORS THAT THEN CORRELATE WITH OR INFLUENCE LEAN AND FAT MASS – I.E. WEIGHT, SEX, AGE, DISEASE/METABOLIC STATUS ETC. WE HAVE NOW ADDED

AN ACCOUNT OF THUS IN THE INTRODUCTION
Authors have assumed that it is mainly the inaccuracies of the predictive formula where the error occurs. They should also explain how the method itself can cause errors depending on which type of machine used, number of electrodes and condition of the participants, which are the major concerns in BIA errors. Also acknowledge the reason why the formulas can't be generalised since they will depend on number of variables discussed in the literature.
THERE IS A KEY DISTINCTION BETWEEN VARIATION DUE TO MEASUREMENT TECHNIQUE AND THOSE DUE TO DIFFERING FORMULAE. MEASUREMENT ERROR IS TO SOME EXTENT RANDOM AND UNAVOIDABLE; WE HAVE PREVIOUSLY FOUND THIS VARIATION TO BE MODEST – NO WORSE THAN MEASUREMENT ERROR FOR HEIGHT. WE HAVE NOW ADDED MENTION OF THIS TO THE INTRODUCTION.
HOWEVER IN CONTRAST VARIATION DUE TO DIFFERING FORMULAE WILL INTRODUCE CONSISTENT AND PREDICTABLE VARIATIONS – AS WE DISCUSS.
13. As previously mentioned in general comments, there are major concerns to be revisited in the development of the estimate, using published constants. And application of such formula to a new population referenced by a completely different sample with different body compositions.
THE CENTRAL ARGUMENT OF THIS PAPER IS THAT FORMULAE NEED TO BE GENERALISED IN ORDER TO MAKE BIA A TRULY VALID MEASURE. THE WHOLE POINT OF THE PUBLISHED CONSTANTS IDENTIFIED IS THAT THEY ARE GENERALISABLE.
14. It is worthy to explore the equations provided by the manufacturer for the BIA machine used here, since the machine used by Jebb et al. by the same manufacturer has documented such a formula.
WE HAVE NOW ADDED A REFERENCE TO THE JEBB FORMULA HERE TOO

15. It is suggested the analytical methods including calculation of lean and fat residuals to be reviewed by an expert statistician.
THE AUTHOR GROUP OF THIS PAPER ALREADY INCLUDES FOUR STATISTICIAN (TWO PROFESSORS, ONE SENIOR LECTURE AND ONE LECTURER) AND IT IS THEY WHO UNDERTOOK AND SUPERVISED THE MAIN ANALYSES.
HOWEVER WE WOULD BE HAPPY FOR THE PAPER TO BE REFERRED FOR STATISTICAL REVIEW.
16. Page 8, 7: It would be much appropriate to use the word "female adults" than "young female adults" since majority of the sample is between 30-53 years.
THANK YOU WE HAVE CORRECTED THIS
17. Table 1: Please be kind enough to correct the following.
The TBW values for Tanita generated data are not included.
THE TBW DATA WERE NOT OUTPUT-ABLE FROM THE TANITA MACHINE. WE HAVE MODIFIED THE TABLE TO MAKE THIS CLEARER.
SI Units for BMI and impedance are not mentioned.
WE HAVE ADDED THESE
Whether LM and TMW differences statistically significant?
THE DATA ARE NOT NORMALLY DISTRIBUTED SO WE WOULD NOT NORMALLY HANDLE THEM PARAMETRICALLY, BUT WE HAVE NOW ADDED A COLUMN FOR THE MEAN DIFFERENCE AND SHOWN THE RESULT FOR A ONE SAMPLE TEST ON THESE VALUES - ALL $P<0.001$
18. Page 8, 27-34: It is suggested that another column, of machine generated values to be included to table 2, stratified by age to directly compare with GMC and historical data.
THE COMPARISON WITH THE MACHINE GENERATED VALUES IS PART OF A SEPARATE QUESTION AND ADDING THIS HERE WOULD ONLY CONFUSE. ALSO THE TABLE IS ALREADY PRETTY CROWDED
19. Page 11 Para 1: After agreeing the difficulty of extrapolating formulas in different populations and methods, authors have gone in to compare the present sample with a historical sample in a different population. The BMI values of the 2 samples differ. GMS mothers' mean BMI is in overweight

category (> 25 kgm2) and in Chumlea it is <25 kgm2.So similarity discussed in lean mass itself is contradictory. It is also not possible to infer the difference if adiposity to secular trends in these 2 groups as these were not the same group of participants who were followed up over the period prospectively. But rather different samples from different countries in different time periods.
WE ARGUE THAT IT IS PERFECTLY REASONABLE TO CONSIDER THAT SUCCESSIVE SIMILAR COHORTS IN DIFFERENT ERAS ARE LIKELY TO BE SUBJECT TO THE WELL KNOWN SECULAR CHANGES IN BODY FAT. WE WOULD STAND BY OUR ASSERTION THAT THE SIMILARITIES IN TBW AND THUS LEAN MASS PROVIDE POWERFUL EVIDENCE THAT THESE FORMULAE ARE VALID AND GERNALSIABLE
20. Page 11 Para 2: Resistivity Constant used which is from the study of Bell had an intercept for the equation, TBW=0.65+0.66 (height2/impedance) .If the intercept is removed from the formula the prediction would be inaccurate. Even it is 'simple', the prediction will be inaccurate only to use the resistivity constant (0.66) in the formula. Additionally the original equation from Bell was derived from a mix group of men and women. This again makes difficult to accurately use that constant in the equation to be used in this sample of only females.
THE CONFIDENCE INTERVALS FOR THE INTERCEPT IN THE PAPER IN QUESTION EMBRACED ZERO AND WE HAD A VERY STRONG BIOLOGICAL REASON FOR ARGUING THAT TBW SHOULD BE DIRECTLY PROPORTIONAL TO HEIGHT2/IMPEDANCE, SO THAT USING AN INTERCEPT WOULD ACTUALLY INTRODUCE INACCURACY.

21. Page 11, 50-52: The authors have generalised the modal to 'most adult women' and further have predicted to be used with men, who have a different body composition to women. It is better the predictions and assumptions to be focused only to the investigated sample.
THE PURPOSE OF THIS PAPER WAS TO MAKE BIA – WHICH IS ALREADY WIDELY USED - MORE ROBUST. IF WE CAN ONLY EVER APPLY FINDINGS TO OUR OWN EXPERIMENTAL GROUPS, THEN RESEARCH WOULD HAVE NO WIDER RELEVANCE.
WE HAVE ADDED FURTHER DISCUSSION IN THE PAPER OF THE EXTENT TO WHICH GENDER DIFFERENCES MIGHT MATTER. HOWEVER IT IS HARD TO SEE WHY THE PHYSICAL PROPERTIES OF TISSUE SHOULD VARY BY GENDER.
22. Page 12, 3-10: It would be appropriate to discuss why resistivity constant was different and in different types of samples. This will further elaborate why one type of constant could not be used to another different population.
WE ASCRIBE THE VARIATION TO "UNUSUAL SAMPLES, ONLY MALES OR SAMPLES COVERING A WIDE AGE RANGE"
23. Page 12, 14-19: Initially in introduction it is said that one reason for doubts about accuracy and precision in BIA is that prediction equations are trade secrets of the BIA Company. Then in discussion it is mentioned that such equations are made available by the company. The covariates are also mentioned. It is better the authors be cautious about these contradictory statements.
WE HAVE NOW MODIFIED THE REFERENCE TO THIS IN THE INTRODUCTION
24. Page 12, 17-22: Since these variables are included in regression equations to maximize the predictive value, it is not accurate to discuss their contribution to the formula in isolation..
WE HAVE NOW ADDED A DESCRIPTION IN THE INTRODUCTION AND THE DISCUSSION OF WHY WE THINK THESE ADDITIONAL VARIABLES ARE USED FOR COMMERCIAL EQUATIONS AND WHY THIS IS WRONG!
Suggest expert statistical opinion on this
SEE ABOVE RE STATISTICAL EXPERTISE
25. Page 12, 31, 40: Please be concerned about the referencing in text (e.g. 'Jebb et al.'). It is mentioned as 'Jebb at all'.
WE HAVE CORRECTED THIS

Reviewer: 2 Aleman-Mateo H Research Center for Food and Developed, Mexico.
Firstly. The title and objectives are very confused. From my understanding the main objective of the

paper was: to assess body composition using a new composed equation based on BIA and compare the estimates with those provided by the manufacturer (BIA/Tanita).
WE HAVE NOW AMENDED THE OBJECTIVES TO MAKE THEM CLEARER
If I am right. These results are not novel for the body composition field,.
WHILE THE DATA ARE NOT NOVEL, THIS APPROACH TO ANALYSING THEM IS. WE HAVE BEEN UNABLE TO IDENTIFY ANY OTHER PAPER ADDRESSING THIS IMPORTANT QUESTION
but the most important limitation is the lack of a gold standard method of body composition for this particular included sample
SEE ABOVE. WE HAVE COMPARED OUR FINDINGS TO PUBLISHED GOLD STANDARD DATA
Using two BIA approaches is not possible to enhance the claimed accuracy state by the authors in first line of the abstract.
WE HAVE NOW REMOVED THE REFERENCE TO ACCURACY AS THIS WAS CONFUSING
In the abstract section there are some results beyond of the stated objectives, but also, this is not valid for validation purpose. i.e. Estimates of lean mass were similar to historical results.
WE HAVE NOW MODIFIED THE OBJECTIVES
Introduction section. The information given for the authors does not lead to the main objectives, but most important issue is the lack of a scientific background that support the generation of new knowledges for the field of body composition and nutritional assessment through the body composition components.
WE HAVE EXTENDED OUR DESCRIPTION OF THE PROBLEMS INHERENT IN TRANSFORMING AND COMPUTING IMPEDANCE DATA AND WE HOPE THAT THIS NOW LEADS MORE LOGICALLY TO OUR AIMS AND OBJECTIVES
Please keep in mind, that when we are talking about the BIA not forget that it is a method based on the two compartment model. Therefore, we must refer to fat free mass instead of lean mass.
FOR PRACTICAL PURPOSES AT THIS LEVEL OF ASSESSMENT THESE ARE THE SAME THING. WE COULD CHANGE THE TERMINOLOGY FOR THIS THROUGHOUT IF THE EDITORS REQUEST IT BUT FOR THE MOMENT WE HAVE NOT DONE SO
Authors should review the concepts of BIA, i.e. impedance is composed of resistance and reactance. It should be very convenient to clarify why BIA is a doubly indirect method. All BIA information related is very confuse, last paragraph; pag. 6
WE HAVE NOW SUBSTANTIALLY EDITED THIS SECTION
Subjects and Methods BIA measured indirectly TBW, and there is an influence of the menstrual cycle on the hydration status, how this was controlled?
IT WAS NOT POSSIBLE TO DO THIS, BUT THE EFFECTS WOULD ONLY INTRODUCE MINOR IMPRECISION
The proposal equation to estimate body composition: LM= 0.66/0.732(height2/Z, assumed the hydration factor estimated from the cadaver analysis. However, most of the 50% of the women included in this study were overweight and had obesity, it is well known that obesity produced several body composition changes and these assumptions are not valid during aging and obesity. For example the hydration in obese people increases significantly. Therefore, this is another important limitation in this study, it deserve more attention in the absence of a gold standard method and valid for obese persons.
MOST OF THESE SUBJECTS WERE NOT OBESE AND BIA MACHINES ON THE MARKET DO NOT SUGGEST THAT THEY ARE NOT APPLICABLE TO OBESE WOMEN – THEIR MAIN USER GROUP!
The proposal of using lean mass and fat mass residual sounds interesting: however, in the absence of a gold standard method this is not a valid procedures, because the authors do not know if the estimated value is the true value.
AS WE STATE ABOVE WE ARGUE THAT THESE ARE COMPARATIVE STATISTICAL MANIPULATIONS FOR WHOM A GOLD STANDARD GROUP IS IRRELEVENT
The Bland and Altman analysis is poorly explained in this section.
A GOOD REFERENCE IS PROVIDED FOR THE BLAND-ALTMAN METHOD (REF 18) BUT WE

HAVE ADDED FURTHER EXPLANATION IN THE TEXT.
In addition, authors before apply this analysis, a paired t test should be used to look if there are significant difference between two BIA methods..
Table 1. I would like to see the results of the comparison by a t-test and to know if the values generated using published constants are different from Tanita generated data
WE HAVE NOW ADDED A T-TEST COMPARISON AS DESCRIBED ABOVE.
The information is only descriptive, but But the most important authors should run an analysis in order to test if the bias is significant or not
Plots should provide statistical evidences about the bias, in other words, if the bias is significant or not, therefore to tests if there is agreement between methods.
THERE IS NO RECOGNISED FORMAL TEST TO APPLY TO DATA IF THIS KIND, BUT WE FITTED A LINEAR REGRESSION TO THE POINTS, AND THIS SHOWED THAT THE ESTIMATED SLOPE COEFFICIENT WAS HIGHLY SIGNIFICANTLY DIFFERENT FROM ZERO. WE HAVE ADDED MENTION OF THIS TO THE RESULTS.
The discussion section is very limited and it does not support any scientific hypothesis and true limitation about BIA technique to assess human body composition.
WE HAVE NOW MADE MAJOR REVISIONS TO THE DISCUSSION BUT CANNOT ARGUE THAT THE BIA TECHNIQUE IS LIMITED – ONLY THE WAY THE DATA GENERATED BY BIA IS USED. WE HAVE TRIED TO MAKE THIS CLEARER

Reviewer: 3 Fanny BUCKINX University of Liège, Belgium
General comment : this study aimed to explore and enhance the accuracy and usefulness of Bioelectrical Impedance Analysis. Overall, the results are interesting and original. Nevertheless, the presentation of the methodology should be better structured and the overall quality of English language should be improved.
THE ENTIRE PAPER HAS BEEN CHECKED AND CORRECTED BY A NATIVE (UK) ENGLISH SPEAKER
In the introduction, the authors state that hydrodensitometry is usually regarded as the gold standard. Another method for body composition assessment is often referenced (i.e. Dual energy X-rays absorptiometry (DXA)) and should be mentioned.
DXA IS ACTUALLY NOT A GOLD STANDARD – RATHER ANOTHER CONTRASTING METHOD WITH INHERENT SOURCES OF ERROR AND BIAS. THIS WAS WELL SHOWN BY (Parker et al., 2003). HOWEVER WE HAVE NOW ADDED MENTION OF THIS AS WELL AS OF ISOTOPE METHODS
In the introduction, the authors wrote: « electrical current through the body (50 kHz alternating current of 800 µA between electrodes) ». This is a single frequency device. Please, specify that multi-frequency bio-impedance analyzers also exist.
WE HAVE NOW ADDED A MENTION OF THESE NEW MACHINES IN THE DISCUSSION
In the introduction the authors wrote: « Although BIA is already widely used in practice and some body composition research, there remain doubts about its accuracy and precision. There are two possible reasons for this. … ». A third reason to mention is that prediction equations are device dependent, even among different types of BIA.
WE HAVE NOW GONE IN TO MORE DETAIL ABOUT THE DIFFERENT TYPE OF ANALYSERS AVAILABLE BUT TRIED TO MAKE IT CLEAR THAT THE MAJOR VARIATION OCCURS WITH VARYING PREDICTION EQUATIONS RATHER THAN DIFFERENT PHYSICAL PRINCIPLES
The methods section should be divided into 2 paragraphs (with subheadings): one on the population and one on the data collection.
WE HAVE DONE THIS
This sentence « 1011 (81%) eligible mothers agreed to join the study » should be moved to the results section.
WE HAVE DONE THIS
« Information was collected on both children and parents and they have now been followed up to age

nine years. ». This is unclear and should be rewritten. Please, specify the kind of information collected.
WE HAVE EXPAND THIS SLIGHTLY AND ADDED CITE TO OUR COHORT PROFILE PAPER IN IJE
« It was possible to collect impedance and growth data on 498 mothers (but only a tiny number of fathers) out of the 1011 who originally entered the study. ». Please, be coherent and specify the number of fathers. Moreover, this information should be moved to the results section. In fact, the first part of the results section should describe the study population.
WE HAVE REDRAFTED THIS SECTION TO MAKE IT CLEAR THAT WE COULD NOT USE THE PATERNAL DATA AND MOVED THE NUMBERS TO THE RESULTS SECTION
The authors state « Written informed consent was obtained from all subjects ». What about the children? Did the authors obtain parental consent?
FOR STUDIES INVOLVING CHILDREN THEIR CONSENT WAS ALSO OBTAINED BUT FOR THIS PAPER ONLY ADULT CONSENT IS RELEVANT.
« The subjects were measured wearing light clothing and bare feet after being asked to empty their bladders ». Were the subjects fasting?
NO, THIS WAS NOT POSSIBLE
In the results section, the author wrote « The GMS adults' data set consists of 498 young adult females mean (SD) age 36.3 (5.6) years. (age range 23.58 – 53.08 yr). Numbers should all be rounded to one decimal place.
WE HAVE DONE THIS
This comparison « Our results are compared with the results from the two historical papers in Table II 16;17, with the GMS mothers stratified by age to allow direct comparability. These revealed that results for LM were very similar, while the trends over time were to increasing weight, BMI and fat mass, except in the oldest mothers. » should be moved to the discussion section.
WE HAVE DONE THIS
In the discussion section, it would be interesting to compare the results obtained in the present study with results obtained with other types of BIA like the Tanita device for example.
WE HAVE NOW ADDED A COMPARISON TO A SYSTEMATIC REVIEW OF BMI COMPARED TO VARIOUS BODY COMPOSITION METHODS
Limitations of this study should be discussed.
WE HAVE ADDED THIS (PAGE 13)
The authors state « While the formulae used by BIA manufacturers may produce useable estimates of percentage fat… » Once more, it should be noted that each device has its own prediction equation.
WE HAVE ADDED THIS (PAGE 14)
In table 1, results are expressed as median and IQR. The means and standard deviations should be added.
THESE DATA WERE NOT ALL NORMALLY DISTRIBUTED BUT WE HAVE NOW ADDED THE MEAN AND SD OF THE DIFFERENCE
In table 1, one can read that the %fat is 34.45. This seems quite high, especially knowing that BIA tends to underestimate body fat. This should be discussed in the appropriate section.
WE HAVE NOW MENTIONED THIS SPECIFICALLY IN THE DISCUSSION (PAGE 10)

PARKER, L., REILLY, J. J., SLATER, C., WELLS, J. C. & PITSILADIS, Y. 2003. Validity of six field and laboratory methods for measurement of body composition in boys. Obes.Res., 11, 852-858.

VERSION 2 – REVIEW

REVIEWER	Fanny buckinx University of Liège, Belgium
REVIEW RETURNED	08-Dec-2015

GENERAL COMMENTS	The reviewer appreciates the efforts made by the authors to respond to moist of my previous comments. The only comment I still have is regarding the “Material and methods” section. The description of the population is still unclear. Do you focus on children, their mothers, their fathers? Please, clarify.

VERSION 2 – AUTHOR RESPONSE

We are delighted to hear that you are now prepared to publish this paper subject to minor revision and have been happy to change the title as requested and a add a clarification to the participant section which was indeed very unclear