PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	What factors are associated with pre pregnancy nutritional status? Baseline analysis of the KITE cohort, a prospective study in northern Ethiopia
AUTHORS	Misgina, Kebede; Boezen, H. Marike; van der Beek, Eline M.; Mulugeta, Afework; Groen, Henk

VERSION 1 – REVIEW

REVIEWER	Buffarini, Romina Universidade Federal de Pelotas, Social Medicine
REVIEW RETURNED	15-Sep-2020

GENERAL COMMENTS	Summary The study by Misgina et al examine the association between several determinants of pre-pregnancy nutritional status in pregnant women aged > 18 years of age. The text is clear, the objective is well and tables (principal and supplementary) and are suitable for the study. Methods sections could be improved because information on measurements is lacking. On the other hand, statistical analyses are explained in detail, giving clear information. Discussion section is incomplete, the authors should explain better several statements and elaborate on strengths and limitations and generalizability of the results. Comments I am curious about missing values, did the authors have complete information in all variables for the total sample? Please, check that all covariates included in the tables are listed and explained in Methods section (e.g.: model household, perceived work burden). Model household seems to be an important determinant, although is only explained in Discussion. Please add the information on this measure in Methods. Fasting is other important determinant of nutritional status. The measurement of this variable should be explained with more details in Methods (unit of fasting: days per week or hours per day or weeks per month?) Please specify the time of fasting Family size: please specify in Methods which is the unit of this variable, e.g.: number of members? Please discuss the possibility of having error type I due to multiple hypothesis testing. This is an important limitation in this study.

	Discussion could be improved Strengths and limitations should be added Please discuss on the generalizability of the findings. Please expand on the results regarding to fasting. This sentence is not clear: Almost all the women that involved in our study were Orthodox Christians, and in this religion more than half of the days in a full year are fasting times.

REVIEWER	Mosquera, Paola Universidade de São Paulo
REVIEW RETURNED	17-Sep-2020

GENERAL COMMENTS	The manuscript submitted by Kebede Haile Misgina and colleagues presents results that would be of interest to the community of scientists and clinicians concerned with maternal pre-pregnancy nutritional status. Prior to publication, the following points should be addressed. Abstract: -Please do not repeat the total number of studied women (n = 991). -Was the prevalence of pre-pregnancy undernutrition 36.2% according to BMI or MUAC? Please, add this information. Introduction: -Please, if possible, provide the references of those few studies: “Few studies have investigated the determinants of pre-pregnancy nutritional status in low-income countries like Ethiopia in detail.” Methods: -Where was pre-pregnancy weight measured (n=17500)? was it at the health post? Was this measurement also performed by the qualified health extension workers? -(Page 7) What do you mean by gravidity? Could you clarify? -(Page 7) In method section you stated that “women who scored ≥ 80% were considered as empowered.[38]”, but in table 4 and 5 this variable was categorized as "women empowerment score < or ≥ 6" why? I suggest you describe it in methods. -(Page 8) Could you review the following statement? “Households experienced none of the food insecurity conditions, or just experienced worry, but rarely were classified as food secure.[31]” If households experienced none of the food insecurity conditions, or just experienced worry, why were they rarely classified as food secure? -(Page 8) Please mention which cutoff points were considered for the scores related to psychosocial characteristics. -(Page 8) You commented that “women were classified as undernourished (BMI < 18.5), normal (BMI=18.5 to 24.9) or overweight (BMI ≥ 25.0). Likewise, MUAC < 21.0 cm was used to define undernutrition.[45]” I also recommend you mention how the dependent variables were used in the analysis. -(Page 9) I cannot comment on piecewise regression statistical method as I am not familiar with it. But, in this section I just would like to ask you to inform the association measure obtained (and its confidence interval) to identify determinants of BMI and MUAC from the linear regression. Results: -In my view, table 1 is not necessary. You could add the anthropometric information in table 2 (and review its tittle). If you

	decide to keep it, add ")" for height in the "total column" and for BMI < 18.5 Kg/m2 in the Undernourished column. (Page 13, line 15) number "208" has a different font size than the rest of the text. (Page 14 and 15) "coefficient" is β-coefficient? Among the variables that explained BMI and MUAC, mention which ones were positively and negatively associated. (Page 14) In relation to MUAC, review that the coefficients mentioned in the text differ from those presented in table 5. Table 2: -The following variables were not clearly described in methods: Time to go to the nearest health facility and back home (is it "self-reported access to health facility"?) and Access to fetching water within 15 minutes (is it part of "access to improved drinking"? If so, make it clearer in methods section). Table 3: The following variables were not mentioned in methods: age at first marriage, age at first birth and previous inter-birth spacing in months. Please complete what includes "history of adverse birth outcome" (in methods) and make sure that all variables shown in tables have been described (and its categorization for analyses) in the method section. Discussion: (Page 15) "These numbers are higher than the national prevalence (22%)… [14])" and (page 4): "In Ethiopia, the prevalence of undernutrition among 14,505 non-pregnant women of reproductive age involved in the 2011 demographic and health survey was 27%.[14]" just confirming, are the % presented correct in both sections? -(Page 17) In the introduction you affirmed that the influence of implementation of a health extension package was not studied well, but isn't there any previous local study to compare your results with? -(Page 17) "Moreover, women empowerment score was associated with higher pre-pregnancy nutritional status in the present study" did you mean higher empowerment score?

REVIEWER	Lourenco, Barbara Universidade de Sao Paulo, Nutrition
REVIEW RETURNED	02-Oct-2020

GENERAL COMMENTS	bmjopen-2020-043484: What factors determine pre-pregnancy nutritional status? A prospective study in Tigrai regional state, Northern Ethiopia The present study aims to address factors associated with pre-pregnancy nutritional status of women in rural and urban areas in Tigrai regional state, Northern Ethiopia. Undernutrition is certainly a matter of great concern in the region and a broad range of factors has been assessed by the authors, with potentially promising results. However, there are several design and methodological clarifications needed, with an impact on the report and the interpretation of findings, as detailed below. 1. Introduction is too long, particularly in its two last paragraphs. The section should be more concise, highlighting the contribution of the present work. Also, although attention was directed to undernutrition, the aim of the study did not approach the condition. In addition to investigating factors associated with BMI and MUAC, I believe authors could provide information on factors associated

	with the condition of undernutrition at the cutoff points of each of these variables. 2. Study design: although the title and the objective indicate that this is a prospective study, I disagree that outcomes of interest were prospectively assessed in relation to exposures for analysis. Timing of each of the measurements in relation to pre-pregnancy BMI and MUAC should be clearly stated –according to the present version of this work, it seems that: (i) BMI was measured months before inclusion of pregnant women in the study (it seems that authors are inferring that BMI has not suffered great variation from its measurement until conception and inclusion in the study); and (ii) at the moment of inclusion of pregnant women, MUAC was assessed, along with the majority of the data on socioeconomic, physical activity, reproductive, obstetric, intimate partner violence, empowerment, food and diet, psychosocial factors. Thus, although part of a prospective study, the present analysis is cross-sectional. The use of "determinants" throughout the manuscript should be avoided. 3. Study population: authors informed the total population of KA-HDSS and the number of pregnancies expected per year (>4,000). A large number of women (of reproductive age?) living in the study area had their weight measured before inclusion of pregnant women in the study (n=17,500). Then, data were available for a total of 991 pregnant women. There is no information on how pregnancy status was tracked, or on the total number of pregnancies registered in the region. What were the follow-up and attrition rates? Were there refusals to participate? Also, for sample calculation the justification is based on the difference in birth weight according to MUAC at a cutoff of 23 cm, which is not in accordance with the cutoff informed in your introduction? Please clarify. 4. Measurements: paragraphs describing measurements are confusing with regards to timing of data collection. There is no explicit information on the source of measurements: from KA-DHSS database, interview, antenatal records? Information is also missing regarding the categorization of variables. Grouping of variables is a bit odd –for instance, authors refer to data collection on physical activity among socioeconomic factors, as well as on intimate partner violence and empowerment amid reproductive and obstetric conditions. The rationale for this is not quite clear to me. I believe that ordering your variables according to a conceptual framework of factors associated with pre-pregnancy nutritional status and undernutrition could be of great help in defining, analyzing and interpreting the "domains" of variables considered. Please check Victora et al. Int J Epidemiol. 1997;26:224-7 (doi: 10.1093/ije/26.1.224). 5. Statistical analysis: what were the parameters with ANOVA for indication of non-linearity? What were the comparisons of piecewise, quadratic and cubic models? Were the distributions of BMI and MUAC normal? Authors refer to spline models in the abstract, but it looks like some variables were only partitioned at specific cutoff points for linear regression models –were splines (cubic?, quadratic?) in fact used? Also, modeling approach is not clear: while I understand that variables with a significant association with outcomes in unadjusted analysis were considered for multiple adjustment, it seems that all were retained in the final model. There are footnotes in tables 4 and 5 indicating adjustment for "husband education, access to health service and improved drinking water, frequencies of fruit, vegetables, animal-source food and alcohol intake" –this was not explained in methods. Please

	clarify your procedures and consider using a conceptual framework of factors associated with pre-pregnancy nutritional status for defining and interpreting proper “domains” of variables. Finally, I suggest additionally performing Poisson regression models with robust variance for estimating factors associated with undernutrition as a categorical variable. This could be of great interest. 6. Results: please consider all methodological aspects outlined above in restructuring your results section. In your text, clearly state the direction of the associations. Plus, note that the symbol ± is not adequate and you may simply indicate SD in parenthesis. In table 2, education is described in categories including: secondary education and above AND above secondary education –please specify in which category participants with above secondary education were allocated. Regarding occupation of husbands: why are drivers indicated in a category with students, unemployed, or others? The rationale is not clear. Why did reference categories in tables 4 and 5 change between unadjusted and adjusted models? Finally, revise titles of tables and the text to refer to unadjusted and adjusted analysis (instead of univariable and multivariable). 7. Discussion: please consider all methodological aspects outlined above in restructuring your discussion section. What were the limitations to your study?

VERSION 1 – AUTHOR RESPONSE

Comments from Reviewer 1

1) I am curious about missing values; did the authors have complete information in all variables for the total sample?

Response: Thank you for your question. Thanks to the data collection with the help of health care workers most data discussed in the present paper are complete, although we did have some missing data for other variables. Most of these variables will be included in subsequent papers. We planned to include season at birth of the participating women in the present manuscript, but most women did not recall it correctly. We therefore decided not to include this variable in the analysis reported in the manuscript.

2) Please, check that all covariates included in the tables are listed and explained in methods section (e.g. model household, perceived work burden).

Response: Thank you for your comment. We have explained all the variables including model household and perceived work burden now in the methods section.

3) Model household seems to be an important determinant, although is only explained in Discussion. Please add the information on this measure in methods.

Response: We agree and we explained model household a little bit more in the methods section of the revised copy as “implementation of health extension package was assessed by checking if the women’s households were certified as a model or not; a model household is a household that received short-term training on and implemented the health extension package after the training’’ (Page 6 lines 3-6).

4) Fasting is other important determinant of nutritional status. The measurement of this variable should be explained with more details in methods (unit of fasting: days per week or hours per day or weeks per month?). Please specify the time of fasting.

Response: Thank you for your comment. In the revised version we provided a more detailed explanation of fasting as “Fasting is abstaining from animal-source foods such as meat, dairy products, egg and fish for religious reasons. Christians fast almost every Wednesday and Friday

weekly throughout the year, in addition to longer fasting periods of several days, including the 40 days Christmas fast, the 55 days of the Lenten fast, at least 14 days of an Apostles' fast and 14 days Dormition fast. Data on fasting was collected by asking women if they fast weekly and adhere to the long fast periods. Women were only categorized as 'fasting' if they fast weekly as well as during the longer fasting periods" (Page 7 lines 13-19).

5) Family size: please specify in methods which is the unit of this variable, e.g.: number of members?

Response: To make it clear for the audience, we have specified family size in the methods as the number of persons living in the same household (Page 5 lines 30-31).

6) Please discuss the possibility of having error type I due to multiple hypothesis testing. This is an important limitation in this study.

Response: Thank you for your comment, we have discussed the possibility of having error type I now in our discussion: "our study might have not been free of type one error due to the multiple hypothesis testing, although most of our findings are biologically plausible and several of the p-values are sufficiently strong to substantially diminish the risk of a chance finding" (Page 19 lines 28-30)

7) Discussion could be improved: using the reviewers' feedback, we have critically reviewed the discussion and adjusted flow and focus where possible.

a) Strengths and limitations should be added

Response: We have added a discussion on strengths and limitations as suggested (Page 19 lines 23-31).

b) Please discuss on the generalizability of the findings.

Response: We have now added several remarks to discuss the generalizability of the findings in the text (Page 20 lines 1-2).

c) Please expand on the results regarding to fasting. This sentence is not clear: Almost all the women that involved in our study were Orthodox Christians, and in this religion more than half of the days in a full year are fasting times.

Response: We have explained fasting as a dietary habit that involves periods of multiple successive fasting days on which foods of animal origin are not consumed in the methods section of the revised copy (as explained above under comment #4). Additionally, we have expanded the discussion regarding to fasting (Page 18 lines 24-30).

Comments from Reviewer 2

Abstract:

1) Please do not repeat the total number of studied women (n=991).

Response: Thank you for your comment. We have avoided the repetition.

2) Was the prevalence of pre-pregnancy undernutrition 36.2% according to BMI or MUAC? Please, add this information.

Response: It was based on BMI. The prevalence based on MUAC was 20.5%. But all the women who were undernourished based on MUAC were also undernourished based on BMI. Hence, we would say it was based on BMI and/or MUAC and we have added the information in the revised version.

Introduction:

1) Please, if possible, provide the references of those few studies: "Few studies have investigated the determinants of pre-pregnancy nutritional status in low-income countries like Ethiopia in detail."

Response: Thank you for your comment. We have cited the references now in the text.

Methods:

1) Where was pre-pregnancy weight measured (n=17,500)? Was it at the health post? Was this measurement also performed by the qualified health extension workers?

Response: Thank you for your question. There are 2 to 3 qualified health extension workers in the health posts located in each kebele (the smallest administrative units) who provide promotional and preventive services under the umbrella of the 'health extension package' mainly at a household level. The pre-pregnancy weight measurement was performed by these Health Extension Workers (HEWs) together with the Women Development Army (WDA) mainly at a household level in collaboration with the district health and KA-HDSS offices. WDA is a network of health information

workers reaching individual households around the health posts. Hence, the WDA helped in mobilizing the women. In some cases, they used opportunities like women gatherings for health education and other topics. It is also important to note that the HEWs spend 80% of their time at home-based promotional and preventive services. We have revised the manuscript in a way that can answer the questions (Page 5 lines 20-29).

2) (Page 7) What do you mean by gravidity? Could you clarify?

Response: We have clarified it in the text as “total number of pregnancies before the index one” to make clear to the audience.

3) (Page 7) In method section you stated that “women who scored ≥ 80% were considered as empowered. [38]”, but in table 4 and 5 this variable was categorized as "women empowerment score < or ≥ 6" why? I suggest you describe it in methods.

Response: You are correct, and this may be confusing. For variables non-linearly associated with the dependent variables, we applied linear splines to account for the non-linearity when appropriate as compared to quadratic and cubic models. That is, two new continuous variables were created by partitioning each of the non-linearly associated independent variables at the knot value (K) into two using the Stata adjust_rcspline package as X< K and X ≥ K. Accordingly, women empowerment score < 6 and women empowerment score ≥ 6 and their respetive intercepts were included as a continuous variables in the linear regression models as described in page 9 not as a categorical variables. To make clearer, the women empowerment scores of 0 to 5 and women empowerment scores 6 to 9 were included into the linear regression modeling as continuous scores.

4) (Page 8) Could you review the following statement? “Households experienced none of the food insecurity conditions, or just experienced worry, but rarely were classified as food secure.[31]” If households experienced none of the food insecurity conditions, or just experienced worry, why were they rarely classified as food secure?

Response: To make it clearer for the audience, we have re-written it as “A household was classified as food secure if the response to all occurrence questions was ‘no’ or if the only ‘yes’ response concerned the question "did you worry that your household would not have enough food" and the frequency of occurrence for the worry about their household would not enough food was ‘rarely’. All other households were classified as food insecure’’ in the revised version (Page 8 lines 3-7).

5) (Page 8) Please mention which cutoff points were considered for the scores related to psychosocial characteristics.

Response: Thank you for your comment. We have mentioned the cutoff points in the text now (Page 8 lines 8-17).

6) (Page 8) You commented that “women were classified as undernourished (BMI < 18.5), normal (BMI=18.5 to 24.9) or overweight (BMI ≥ 25.0). Likewise, MUAC < 21.0 cm was used to define undernutrition.[45]” I also recommend you mention how the dependent variables were used in the analysis.

Response: Thank you for your comment. The dependent variables were used as continuous measures and we have mentioned it in the revised copy (Page 9 line 3).

7) (Page 9) I cannot comment on piecewise regression statistical method as I am not familiar with it. But, in this section I just would like to ask you to inform the association measure obtained (and its confidence interval) to identify determinants of BMI and MUAC from the linear regression.

Response: We have revised the text as suggested. Additionally, we believe that linear spline is more general and clearer terminology than piecewise regression. Hence, we replaced the phrase piecewise with linear spline (Page 9 line 26).

Results:

8) In my view, table 1 is not necessary. You could add the anthropometric information in table 2 (and review its tittle). If you decide to keep it, add “)” for height in the “total column” and for BMI < 18.5 Kg/m^2 in the Undernourished column.

Response: Thank you for your comment. Considering the similarity of the content, we could merge table 1 with table 3. But, as we want to start the results section with a brief description of nutritional status of the participating women, we preferred to leave it as it is.

9) (Page 13, line 15) number “208” has a different font size than the rest of the text.
Response: Thank you! We have corrected it.
10) (Page 14 and 15) “coefficient” is β-coefficient? Among the variables that explained BMI and MUAC, mention which ones were positively and negatively associated.
Response: Yes, we mean B-coefficient. In the revised version, we indicated the direction of association.
11) (Page 14) In relation to MUAC, review that the coefficients mentioned in the text differs from those presented in table 5.
Response: Some of the coefficients mentioned were from table 4 for BMI not for MUAC. Thank you! We have corrected the coefficients now.
12) Table 2: The following variables were not clearly described in methods: Time to go to the nearest health facility and back home (is it “self-reported access to health facility”?) and Access to fetching water within 15 minutes (is it part of “access to improved drinking water”? If so, make it clearer in methods section).
Response: Yes, it is true that access to health facility is time to go to the nearby health facility and back home. Access to fetching water within 15 minutes was to mean time required to fetch water from the improved source of drinking water. Hence, we have made it clear in the text. Also, we have clearly defined improved source of drinking water and sanitation facilities in the methods section of the revised version (Page 6 lines 2-3 and lines 14-18).
13) Table 3: The following variables were not mentioned in methods: age at first marriage, age at first birth and previous inter-birth spacing in months. Please complete what includes “history of adverse birth outcome” (in methods) and make sure that all variables shown in tables have been described (and its categorization for analyses) in the method section.
Response: We have included the variables such as age at first marriage, age at first birth, previous inter-birth spacing in months, and history of adverse birth outcome in the revised version (Page 6 lines 26-30).
Discussion:
14) (Page 15) "These numbers are higher than the national prevalence (22%)… [14])" and (page 4): "In Ethiopia, the prevalence of undernutrition among 14,505 non-pregnant women of reproductive age involved in the 2011 demographic and health survey was 27%.[14]" just confirming, are the % presented correct in both sections?
Response: Thank you for your comment. The reference we cited should have been the latest one (the 2016 demographic and health survey report not the 2011) and the prevalence mentioned in the introduction should have been replaced with the latest report. Hence, we have corrected this in the revised copy.
15) -(Page 17) In the introduction you affirmed that the influence of implementation of a health extension package was not studied well, but isn’t there any previous local study to compare your results with?
Response: Thank you for your question. As to our knowledge, we are not aware of any local study.
16) -(Page 17) “Moreover, women empowerment score was associated with higher pre-pregnancy nutritional status in the present study” did you mean higher empowerment score?
Response: Thank you for comment. It is true that we meant higher empowerment score. We have revised the text accordingly.
Comments from Reviewer 3
Introduction:
1) Introduction is too long, particularly in its two last paragraphs. The section should be more concise, highlighting the contribution of the present work. Also, although attention was directed to undernutrition, the aim of the study did not approach the condition. In addition to investigating factors associated with BMI and MUAC, I believe authors could provide information on factors associated with the condition of undernutrition at the cutoff points of each of these variables.
Response: Thank you so much for your comment. We have shortened the introduction mainly in the last two paragraphs. Concerning the associated factors, although the attention was

directed to under-nutrition in the introduction to define and show the magnitude of the problem, we think that providing a brief summary of factors associated with pre-pregnancy nutritional status in general as we did in the third paragraph of the introduction is ok for the type of analysis we did. If we had approached the analysis using the standard cut offs for undernutrition as you suggested, we agree that summarizing the factors associated with pre-pregnancy nutritional status at the cutoff points (low body mass index (BMI) < 18.5 kg/m^2 and mid-upper arm circumference (MUAC) < 21 cm) would have been better. Hence, we think that this specific comment is related to the analysis performed as also addressed in the last comment regarding the statistical analysis. This suggested Poisson regression models with robust variance as additional analysis for estimating factors associated with undernutrition as a categorical variable. However, we did not see the importance of performing both logistic /modified Poisson regression and linear regression because we would not add new or different insights.

Any additional analysis should add something to the paper for instance like estimating the effect of optimization of some of the important factors on pre-pregnancy nutritional status by calculating predicted probabilities of being normal weight (BMI > 18.5 kg/m^2) based on a multivariable logistic regression model using marginal standardization using the Stata command 'margins'

Study design:

1) Although the title and the objective indicate that this is a prospective study, I disagree that outcomes of interest were prospectively assessed in relation to exposures for analysis. Timing of each of the measurements in relation to pre-pregnancy BMI and MUAC should be clearly stated – according to the present version of this work, it seems that: (i) BMI was measured months before inclusion of pregnant women in the study (it seems that authors are inferring that BMI has not suffered great variation from its measurement until conception and inclusion in the study); and (ii) at the moment of inclusion of pregnant women, MUAC was assessed, along with the majority of the data on socioeconomic, physical activity, reproductive, obstetric, intimate partner violence, empowerment, food and diet, psychosocial factors. Thus, although part of a prospective study, the present analysis is cross-sectional. The use of "determinants" should be avoided.

Response: Thank you for your comment. Our study was partly prospective and partly not. Hence, we agree with your view and now avoid using the term "determinants" throughout the manuscript. Also, we have revised the title accordingly.

In reference to timing of each of the measurements in relation to pre-pregnancy BMI and MUAC, most of the data included in the analysis of the present paper were collected at inclusion. The remainder were extracted from the KA-HDSS database. The variables extracted from the database (age, residence, religion, education of the participating women, occupation of the participating women, husband education, husband occupation, family size, wealth index, gravidity, parity, and history of abortion as well as history of stillbirth) were collected recently and are data that do not change over a short period of time. The only variable that the KA-HDSS does not update regularly is wealth index. Hence, for this variable we asked the participants for any change since the last interview. In addition, agrobiodiversity data was available in the KA-HDSS database but the surveillance site does not update this data regularly and this was something that cannot be updated easily. Since it also greatly varies over time, we have collected the data ourselves at inclusion.

Study population:

1) Authors informed the total population of KA-HDSS and the number of pregnancies expected per year (> 4,000). A large number of women (of reproductive age?) living in the study area had their weight measured before inclusion of pregnant women in the study (n=17,500). Then, data were available for a total of 991 pregnant women. Theres no information on how pregnancy status was tracked, or on the total number of pregnancies registered in the region. What were the follow-up and attrition rates? Were there refusals to participate?

Response: Thank you for your comments and questions. It is true that the women whose weight was measured before enrollment were non-pregnant women of reproductive age. We have mentioned it in the revised copy.

Regarding the information on how pregnancy status was tracked, we used different methods to identify pregnant women.

I) As one of the responsibilities of the Health Extension Workers (HEWs) in the respective kebeles is to identify pregnant women and provide appropriate help, HEWs identified the pregnant women with the help of the Women's Development Army (WDA); a network of health information workers reaching individual households around the health posts.

II) Additionally, we used the list from the records of the nearby antenatal clinics as well as from the Kilite-Awilaelo Health and Demographic Surveillance Site (KA-HDSS) database. KA-HDSS has resident data collectors who are also responsible to identify and report the vital events including pregnancy, birth and deaths at a monthly basis.

III) Furthermore, there was a trachoma campaign in which a trachoma preventive treatment is given to all residents of all kebeles by the HEWs. As the trachoma preventive treatment is contraindicated in the first trimester of pregnancy, women were expected to report their pregnancy status before receiving the preventive therapy. We, therefore, used this opportunity to identify pregnant women for possible inclusion.

IV) In addition, there is safety net program in the region in which people work for food. There is also a mandatory 20-day civil service per year during which water and soil conservation activities have to be performed. These programs exempt pregnant women. In doing so, pregnant women are supposed to report their pregnancy status to the HEWs who are responsible to write a letter of confirmation to the concerned bodies.

As for to the number of pregnant women registered, firstly we want to make clear that the 4,500 pregnancies expected to occur per year was calculated based on the regional conversion factor (4% of the total population). Hence, the 4,500 expected number of pregnancies may be higher (or lower) than the actual number. Secondly, we did not record the total number of women who became pregnant from the 17,500 non-pregnant women of reproductive age whose weight was measured. What we did, starting three months after the pre-pregnancy weight measurement, is including all eligible pregnant women identified during the subsequent data collection period. At the end of the data collection, we were able to include 991 eligible women from all the pregnancies we have identified.

Coming to the follow-up and attrition rates as well as refusal to participate, we did not have loss to follow-up at this stage because this was the baseline for the prospective study. We simply included all eligible pregnant women identified during the study period. However, in the subsequent stages of data collection at 32 to 36 weeks of gestation, at birth or immediately after birth, and at 18 to 24 months postpartum, we had several cases of lost to follow-up (e.g. 39.8% in the last stage).

We did not have refusal to participate due to the way of working in which we used Health Extension Workers as data collectors who closely work with the women in the respective kebelles (the smallest administrative units in the study area).

2) Also, for sample calculation the justification is based on the difference in birth weight according to MUAC at a cutoff of 23 cm, which is not in accordance with the cutoff informed in your introduction? Please clarify.

Response: It is true that we have used a cutoff different from the cutoff mentioned in the introduction. The sample size calculated was based on selected outcomes for each of the objectives of the project which covers pre-pregnancy maternal nutrition, gestational weight gain, the influence of maternal nutrition prior to and during pregnancy, postpartum maternal nutrition, and child growth. Therefore, we used MUAC at a cutoff of 23 cm to calculate the sample size to address the influence of maternal nutrition prior to and during pregnancy on adverse pregnancy outcomes which gave 1,100 final sample (including the 10% contingency for dropout rate). The sample size of the study, e.g.

n=991, was well above the sample size needed for the data reported in the present manuscript (see below).

a) for estimating the prevalence of under-nutrition defined as BMI < 18.5 kg/m^{2}and/or MUAC < 21.0 cm, assuming a 50% estimated prevalence of undernutrition, 95% confidence interval, 5% marginal error and a 10% non-response rate, the calculated sample would have been 423 women.
b) for estimating the difference between two proportions, assuming a 5% alpha level (two-sided) and 80% power, a 35.1% prevalence of under-nutrition among women who consume their meal at least three times per day versus a 61.9% prevalence of under nutrition among women who consume two times or lower) (Abraham et al. BMC Nutr 1, 12 (2015). DOI 10.1186/s40795-015-0005-y), and a 10% non-response rate, the final sample size would have been 199 women. Considering household food security status as an exposure with a prevalence of 39.1% under-nutrition among food secure versus 61.7% among food insecure households (Abraham et al. BMC Nutr 1, 12 (2015). DOI 10.1186/s40795-015-0005-y), the final sample would have been 161 women.
c) for estimating the difference between two means, assuming a 5% alpha level (two-sided) and 80% power, effect sizes ≥ 0.2 standard deviations (SD), a total sample of 872 would be needed.

Therefore, we have taken the sample size calculated to address one of the objectives of the prospective study for which the calculated sample size was the highest compared to the others.
Measurements:
1) Paragraphs describing measurements are confusing with regards to timing of data collection. There is no explicit information on the source of measurements: from KA-DHSS database, interview, and antenatal records? Information is also missing regarding the categorization of variables. Grouping of variables is a bit odd –for instance, authors refer to data collection on physical activity among socioeconomic factors, as well as on intimate partner violence and empowerment amid reproductive and obstetric conditions. The rationale for this is not quite clear to me. I believe that ordering your variables according to a conceptual framework of factors associated with pre-pregnancy nutritional status and undernutrition could be of great help in defining, analyzing and interpreting the "domains" of variables considered. Please check Victora et al. Int J Epidemiol. 1997;26:224-7 PubMed (doi: 10.1093/ije/26.1.224).
Response: Thank you for your comment. Concerning the source and timing of the variables, we have now described this more clearly in the methods section. For example, under the subtopic of measurements in the beginning of the second and fifth paragraphs we have listed the variables extracted from the KA-DHSS database and also we have clearly described which data were collected by interview at inclusion. Briefly: age, residence, religion, education of the participating women, occupation of the participating women, husband education, husband occupation, family size, wealth index, gravidity, parity, and history of abortion as well as history of stillbirth were all extracted from the KA-DHSS database. All the data collected for these variables were recent except for wealth index which the KA-DHSSdoes not update regularly. For this specific variable, we have just asked the respondents for any change since the last interview and updated it when a change was reported. The remaining variables considered in the study were collected at inclusion by interview when also anthropometric measurements were taken. As for the categorization of the variables, we revised the manuscript in a way that better shows how the variables were categorized (e.g. page 8 paragraph 2).

Using antenatal records, we have extracted data on several variables considered in the present manuscript, e.g. data was available on age, residence, gravidity, parity, history of pre-pregnancy illness (partly), history of stillbirth, history of abortion, gestational age, MUAC (not in all health facilities), and weight. Finally, only data on gestational age was used from the records in the present study for women who did not recall their last menstrual period (LMP). The remainders were used to cross-check the data that were collected.

Concerning the grouping of variables, we understand and agree that the grouping may not be perfect. However, we did not include an analysis on the relative importance of the domains, and thus do not think that the domain by domain analysis is relevant to include, but rather reported on the main analysis. Indeed, for the descriptive part we can consider some revisions on the grouping of variables. For example, we can move physical activity and perceived work burden to the food and dietary characteristics and modify the title as food, dietary and lifestyle characteristics. Also, we could additionally include pre-pregnancy illness under the reproductive and obstetric group and modify the title as reproductive, medical and obstetric conditions. As for women empowerment and intimate partner violence, we believe this parameter belongs to the reproductive and obstetric group although it can also be included under socioeconomic characteristics. For now, we kept the groupings in its original state.

For the conceptual framework, we think that all the individual and group of variables we considered in the present study are in agreement with the known framework of the causes of undernutrition developed by UNICEF that recognizes the basic, underlying and immediate causes (Black et al. The Lancet. 2008; 371243-260. DOI: 10.1016/S0140-6736(07)61690-0).
Statistical analysis:
1) What were the parameters with ANOVA for indication of non-linearity?
Response: Thank you for your comment. We have mentioned the indication for non-linearity in the text.
2) What were the comparisons of piecewise, quadratic and cubic models?
Response: Firstly, we want to make clear that by piecewise regression we are referring to linear spline regression. Hence, we now replaced the term piecewise with linear spline regression throughout the manuscript. Coming to the question, before fitting the final model, we checked for non-linearity. For variables non-linearly associated with the dependent variable(s), we created two new continuous variables by partitioning each non-linear independent variable at the knot value K using Stata adjust rcspline package. Then, we fitted the piecewise (linear spline), the cubic and the quadratic models separately. For instance, for an independent variable X, the models were fitted using the stata code as reg BMI int_1 X< K int_2 X ≥ K, robust for the piecewise (linear spline), reg BMI X X^2, robust for quadratic, reg BMI X X^2 X^3, robust for cubic. Finally, a model that fitted best was considered in the final analysis. A model with the lowest mean squared error and highest variation explained was considered as the best fitted. Hence, the comparison was based on mean squared error and total variation explained.
3) Were the distributions of BMI and MUAC normal?
Response: Yes, they were normally distributed as checked by histograms, normal probability and quantile-quantile plots.
4) Authors refer to spline models in the abstract, but it looks like some variables were only partitioned at specific cutoff points for linear regression models –were splines (cubic?, quadratic?) in fact used?
Response: Testing for non-linearity, quadratic, cubic and linear spline (piecewise regression) models were compared for each of the independent variables with non-linear associations. If cubic model was the best fitted for an independent variable X, we have included X, X^2, and X^3 in the adjusted linear regression model. Moreover, if quadratic model was the best fitted for an independent variable X, we included X, and X^2 in the adjusted linear regression model. Similarly, if the piecewise (linear spline) regression was found to be the best fitted, the linear spline variables X < K and X ≥ K with their respective intercepts (int_1 and int_2 respectively) were included into the final model. In conclusion, basically the final modeling was linear. The linear splines were used to account for non-linearity when appropriate. We preferred the linear splines than the restricted cubic splines because the non-linearity was less curved.
5) Also, modeling approach is not clear: while I understand that variables with a significant association with outcomes in unadjusted analysis were considered for multiple adjustments, it seems that all were retained in the final model. There are footnotes in tables 4 and 5 indicating adjustment

for “husband education, access to health service and improved drinking water, frequencies of fruit, vegetables, animal-source food and alcohol intake” –this was not explained in methods. Please clarify your procedures and consider using a conceptual framework of factors associated with pre-pregnancy nutritional status for defining and interpreting proper “domains” of variables.
Response: It is true that all variables with a statistically significant association with outcomes in unadjusted analysis were considered for multiple adjustments as stated under the statistical analysis. As regards to the footnote, it is to show that the models were additionally adjusted for the variables listed in the footnote. Concerning the domains and conceptual framework, see our response to the question and comment #1 under the subtopic measurement. We made the footnote clearer now.
6) Finally, I suggest additionally performing Poisson regression models with robust variance for estimating factors associated with undernutrition as a categorical variable. This could be of great interest.
Response: Thank you for your suggestion. However, we feel that performing the Poisson regression with undernutrition as a categorical variable would be less appropriate than the linear/non-linear regressions that we performed. Our analyses were done as an open approach to find the most suitable linear or non-linear relationship between pre-pregnancy nutritional status and possible associated variables. Hence, we believe that the linear regression we did is adequate because we would not add new or different insights by performing modified Poisson regression analysis. Secondly, the study design was partly cross-sectional (and partly prospective), and since modified Poisson regression modeling is more suitable for cohort rather than cross-sectional studies, we feel this may confuse the readers. We have explained more about this in our response to the first comment concerning the introduction of the manuscript as well (see page 7 above).
Results:
1) Please consider all methodological aspects outlined above in restructuring your results section. In your text, clearly state the direction of the associations. Plus, note that the symbol ± is not adequate and you may simply indicate SD in parenthesis.
Response: Thank you! We have revised the manuscript as suggested.
2) In table 2, education is described in categories including: secondary education and above AND above secondary education –please specify in which category participants with above secondary education were allocated.
Response: Thank you for your comment. In the category “secondary and above education’’ only women with secondary education were included. Women with above secondary education were included only in the above secondary education category. Hence, we have corrected the typographical error.
3) Regarding occupation of husbands: why are drivers indicated in a category with students, unemployed, or others? The rationale is not clear.
Response: We had no specific reason other than that the frequencies of some of the categories including drivers, students, unemployed, and others were (very) small, and thus we merged them together. To make it clear for the audience, we replaced the category with “others’’ and mentioned what the “others’’ category consists of in the footnote. Also, in the context of Ethiopia, driving is not a permanent job with permanent salary unless they are government and some non-governmental organizations (NGOs) employee which requires some level of education as well.
4) Why did reference categories in tables 4 and 5 change between unadjusted and adjusted models?
Response: It is true, there were inconsistencies with respect to the reference categories between the adjusted and unadjusted analysis. Thank you! We have corrected it now.
5) Finally, revise titles of tables and the text to refer to unadjusted and adjusted analysis (instead of univariable and multivariable).
Response: Thank you for comment! To be consistent with using words and/or phrases, we have just replaced univariable and multivariable with unadjusted and adjusted analysis.
Discussion:

1) Please consider all methodological aspects outlined above in restructuring your discussion section. What were the limitations to your study?
Response: We have restructured the manuscript according to the reviewers' comments including the discussion. In revising our discussion, we have discussed the limitation of the study and the generalizability of our findings (Page 19 lines 23-31).

VERSION 2 – REVIEW

REVIEWER	Mosquera, Paola Universidade de São Paulo
REVIEW RETURNED	08-Jan-2021

GENERAL COMMENTS	The authors followed most of the reviewer's suggestions; however, some points still need to be reviewed. The general comments below may guide the authors: Abstract (results): age <30? Methods: -Information is still missing regarding the categorization of variables in methods section: socioeconomic variables, physical activity, reproductive and obstetric conditions. -"anthropometric measurements as per standard techniques" Could you provide the references of the standardized techniques? -Please, specify that "coefficient" is β-coefficient in Statistical analysis section. -Page 13, line 41: "In addition, 392 (39.6%) women did not have adequate food security. In the univariable analysis…" unadjusted? Tables: -Time to fetching water within 15 minutes, education of husband and occupation of husband were not described in methods section. -"Access to health service within 1 h" Please, avoid abbreviations or describe it in footnotes. -Please, review the labels of the categories in the wealth index. You can name the quintiles from the first (lowest) to the fifth (highest), instead of "the lowest, second, middle…" -"Previous inter-birth spacing in months (table 3)" or "previous inter-birth interval in months (methods)"? Education (table 1) or Educational status (table 4)? Check all the variables and make sure the terms you choose are consistent. Discussion: -The following paragraph is repeated in the text (page 17): "Being from a model household, a proxy for implementation of…." -The following paragraph is repeated in the text (page 19): "The findings of the present study indicate that coordinated and considerable efforts…" -Age<30 was not discussed. The language quality should be verified, since punctuation marks issues can be identified over the manuscript, compromising the structure and organization of the text.

REVIEWER	Lourenco, Barbara

	Universidade de Sao Paulo, Nutrition
REVIEW RETURNED	17-Feb-2021

GENERAL COMMENTS	bmjopen-2020-043484.R1: What factors are associated with pre pregnancy nutritional status? Baseline analysis of a prospective study in Northern Ethiopia My comments have been only partially addressed in the revised version of this manuscript. Also, it is worthy of attention that in the point-by point response authors failed to indicate pages and line numbers for amendments while answering to the topics raised in my review. Several concerns therefore remain: 1. First, modeling approach is still not clear for the adjusted models in tables 4 and 5: it seems that all independent variables, irrespective of their statistical association with the dependent variables, were retained in the final models. What was the rationale for keeping educational status, husband occupation, wealth index, physical activity, coffee intake, and several scores related to psychosocial characteristics in the adjusted models for BMI and MUAC? These variables did not seem to be statistically relevant. Also, why did authors perform additional adjustments for "husband education, access to health service and improved drinking water, frequencies of fruit, vegetables, animal-source food and alcohol intake"? If the modeling approach is not reasonable, it is quite difficult to assess whether the findings are properly presented and discussed. 2. Although a long response was given regarding the identification of pregnancies, not all methods cited for tracking pregnant women were stated in the manuscript. Also, it is still not clear how these women were invited to participate in the study. There is no information on refusals to participate in the revised version of the manuscript. 3. From the authors' point-by-point response, I may assume that data on access to health facilities, work burden, physical activity, pre-pregnancy illnesses, food and dietary characteristics, and psychosocial characteristics were gathered at inclusion of pregnant women, during the interview –but this is also not clear in the manuscript. Additionally, stating that the remaining information was extracted from the KA-DHSS database does not inform on the timing of collection of these variables. When were the KA-DHSS databases updated? 4. Regarding the suggestion for additionally informing on factors associated with undernutrition as a categorical variable: Poisson regression models with robust variance are suitable for estimating prevalence ratios (please see: Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. BMC Med Res Methodol. 2003; 3: 21. DOI: 10.1186/1471-2288-3-21). Such findings could be presented in supplementary files and might be quite informative from a public health perspective. 5. Limitations have been poorly discussed. Very importantly, p-values were mentioned as strong evidence to "diminish the risk of a chance finding" –which is incorrect. Please see: The ASA Statement on p-values: context, process, and purpose. The American Statistician. 2016; 70: 2, 129-133. DOI:10.1080/00031305.2016.1154108). Also, authors stated that "we do not believe that the limitations have affected the generalizability of our findings" –could you elaborate on that? 6. An overall English review would benefit readability of the manuscript.

	Minor observations: please adhere to the International System of Units and do not capitalize kg; table 1 should clearly indicate that BMI is pre-pregnancy; there are still mentions to univariable/multivariable analysis in the text; the reference category for husband occupation is different in unadjusted and adjusted models in tables 4 and 5.

VERSION 2 – AUTHOR RESPONSE

Comments from reviewer: 2.

Abstract :

1. Age < 30 was not mentioned in the abstract

Response: Thank you for pointing out this omission. We have mentioned it in the revised version (Page 2, line 22).

Methods:

1. Information is still missing regarding the categorization of variables in the methods section: socioeconomic variables, physical activity, reproductive and obstetric conditions.

Response: Thank you for your comment. We have indicated how each variable was categorized in the methods section of the revised manuscript (Page 6, lines 11-15; and Page 7 lines 1-5 and 16).

2. "Anthropometric measurements as per standard techniques" Could you provide the references of the standardized techniques?

Response: We have cited the reference in the revised manuscript (Page 6, line 6).

3. Please, specify that "coefficient" is β-coefficient in Statistical analysis section.

Response: We have specified that "coefficient" is β-coefficient (Page 10, line 31)

4. Page 13, line 41: "In addition, 392 (39.6%) women did not have adequate food security. In the univariable analysis…" unadjusted?

Response: Thank you for pointing out this slight inconsistency. We have changed 'univariable' to 'unadjusted' as recommended (Page 14, line 11).

Tables:

1. Time to fetching water within 15 minutes, education of husband and occupation of husband were not described in methods section.

Response: Thank you for your comment. We have described all of these variables in the revised manuscript (Page 6, lines 11-15; and Page 7, lines 1-4). Time to fetch water was collected by asking "What is the time needed to fetch improved drinking water from the nearest source in minutes?" and was dichotomized into "Time to fetch water within 15 minutes'' in the previous

version. In the revised manuscript, we have changed it to “Time needed to fetch water not exceed 30 minutes” to make it comparable with WHO recommendations (Page 7, lines 1-4). According to WHO, a round trip exceeding 30 minutes to collect water implies limited service (For details, see Progress on household drinking water, sanitation, and hygiene 2000-2017. Special focus on inequalities. New York: United Nations Children’s Fund (UNICEF) and World Heath Organization, 2019).

2. “Access to health service within 1 h” Please, avoid abbreviations or describe it in footnotes.

Response: As suggested, we have spelled out the abbreviation “ h” (table 2)

3. Please, review the labels of the categories in the wealth index. You can name the quintiles from the first (lowest) to the fifth (highest), instead of “the lowest, second, middle…”

Response: Thank you. We have revised the labels of the wealth index categories as lowest, low, middle, high and highest as suggested (Page 6, line 27; and tables 2 and 4)

4. “Previous inter-birth spacing in months (table 3)” or “previous inter-birth interval in months (methods)”?

Response: Thank you. Now we have used the phrase “previous inter-birth spacing in months’’ consistently (Page7, line 22).

5. Education (table 1) or Educational status (table 4)? Check all the variables and make sure the terms you choose are consistent.

Response: Thank you. We have used the phrase educational status consistently in the revised version (Page 6, line 12; and tables 1, 4, and 5). We have also checked the manuscript for any inconsistencies in using terms or phrases and corrected when necessary.

Discussion:

1. The following paragraph is repeated in the text (page 17): “Being from a model household, a proxy for implementation of….”

Response: Thank you so much. We have corrected it in the revised version (Page19)

2. The following paragraph is repeated in the text (page 19): “The findings of the present study indicate that coordinated and considerable efforts…”

Response: Thank you. Repetition was avoided in the revised version (Pages 20-21)

3. Age < 30 was not discussed.

Response: Thank you for pointing out this omission. We have discussed it in the revised version as "Age until 29 years was positively associated with pre-pregnancy nutritional status and negatively but insignificantly after 29. This finding implies an association between lower age and lower pre-pregnancy nutritional status. Lower schooling, socioeconomic status, and dietary practice could partly explain the relation between lower age and lower nutritional status. Similar finding has been reported by studies in Ethiopia'' (Page 19, lines 13-17).

4. The language quality should be verified, since punctuation marks issues can be identified over the manuscript, compromising the structure and organization of the text.

Response: We did thorough language checks, and several amendments were made to the manuscript (partly marked).

Comments from reviewer: 3.

1. First, modeling approach is still not clear for the adjusted models in tables 4 and 5: it seems that all independent variables, irrespective of their statistical association with the dependent variables, were retained in the final models. What was the rationale for keeping educational status, husband occupation, wealth index, physical activity, coffee intake, and several scores related to psychosocial characteristics in the adjusted models for BMI and MUAC? These variables did not seem to be statistically relevant. Also, why did authors perform additional adjustments for "husband education, access to health service and improved drinking water, frequencies of fruit, vegetables, animal-source food, and alcohol intake"? If the modeling approach is not reasonable, it is quite difficult to assess whether the findings are properly presented and discussed.

Response: Thank you for your comment and suggestions. In fact, statistical association has been used as a criterion to select independent variables for the final models. However, for some of these variables, there was no literature to support an association with the dependent variables. Another problem was that some of the variables included in the adjusted analysis addressed the same subject in different ways. For instance, frequencies of fruit, vegetables, and animal-source food intake were also implicitly addressed by assessing dietary diversity, a proxy for dietary quality.

Therefore, we have re-evaluated our modeling approach to improve clarity, simplicity, and reasonability. As a result, we have chosen a different approach to the selection of relevant variables for the final models. That is, selection of variables was guided by the conceptual framework of the possible causes of maternal undernutrition developed by UNICEF (see figure 1) besides to the statisticl association with the dependent variables in the unadjusted analysis.

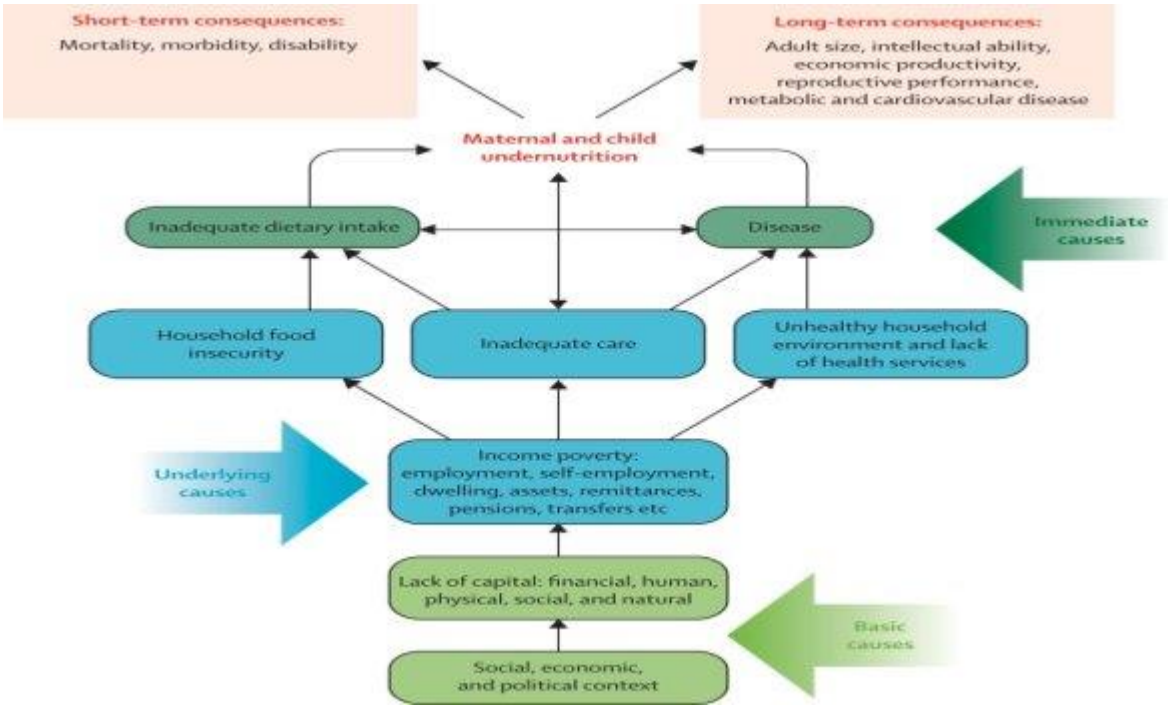

Figure 1: Framework showing the possible causes of maternal undernutrition (for details see Black et al. Maternal and child undernutrition. The Lancet 2008; 371 (9608): 243-260. DOI:10.1016/S0140-6736(07)61690-0).

According to the framework, the possible causes of malnutrition are divided into basic causes, underlying causes, and immediate causes. We have assigned the variables in our database to one of these categories. We did not identify any of our variables as basic causes. Food insecurity, agrobiodiversity, access to health service, implementation of the health extension package, access to an improved source of drinking water, access to an improved sanitation facility, educational status, wealth index, women empowerment, intimate partner violence, and social support were considered to reflect underlying causes. We identified history of pre-pregnancy illnesses, distress, fasting, and dietary diversity (as a proxy for dietary intake) as the variables representing immediate causes. We believe that restructuring our analytical approach according to this framework provides clarity and addresses the reviewer's comment.

As part of the revised modeling approach, we have also addressed psychosocial characteristics in a different way. Instead of including anxiety, depression, and stress separately, we have created a total distress score by summing scores on the three domains. Similarly, we have created a total social support score by merging partner support and support from other social sources. Total distress and total social support scores were, then, included in the final models based on their statistical association with the dependent variables in the unadjusted analysis. This is described in the methods and results sections of the revised manuscript (Page 9, lines 10-12, and 19-21; Page 14, lines 15-19; Page 16 line 21; Page 18 line 3; and table 3).

In summary, selection of relevant variables for the final model was made based on the literature and statistical association in the unadjusted analysis. With this new modeling approach, only slight differences were observed in the findings, which do not change the conclusions.

2. Although a long response was given regarding the identification of pregnancies, not all methods cited for tracking pregnant women were stated in the manuscript. Also, it is still not clear how these women were invited to participate in the study. There is no information on refusals to participate in the revised version of the manuscript.

Response: Thank you for your comment. All methods applied to track pregnant women and how these women were invited to participate in the study are now stated in the manuscript (Page 5, lines 15-31) as follows:

“Different methods were applied to identify pregnant women, including a community-based survey by Health Extension Workers through the “Women Development Army” (WDA), a network of health information workers reaching individual households around the health posts. The records of the nearby antenatal clinics and the KA-HDSS database were also used. In addition, we identified pregnant women through two ongoing projects in Ethiopia. The first project concerns a Productive Safety Net Programme that is being implemented, aiming to improve food security through the participation of households in community asset building projects and earn a wage either in cash or in-kind. Also, households are expected to participate in soil and water conservation activities at least 20 days per year for free. In both cases, pregnant women are exempted upon reporting their pregnancy status to the HEWs, allowing us to identify them for participation.

Furthermore, a campaign offering trachoma treatment was taking place during the data collection period in the study area. As the treatment is contraindicated in the first trimester of pregnancy, women had to report their pregnancy status to HEWs. The opportunity was, therefore, used to identify pregnant women. All eligible pregnant women identified during the study period through any of the aforementioned methods were visited at their homes, invited for the study and included consecutively. ’’

Concerning refusals, all the approached eligible women participated in the study at least at baseline. Hence, we had no refusals at this stage. We have indicated this in the manuscript (Page, 11 line 14).

3. From the authors’ point-by-point response, I may assume that data on access to health facilities, work burden, physical activity, pre-pregnancy illnesses, food and dietary characteristics, and psychosocial characteristics were gathered at inclusion of pregnant women, during the interview –but this is also not clear in the manuscript. Additionally, stating that the remaining information was extracted from the KA-DHSS database does not inform on the timing of collection of these variables. When were the KA-DHSS databases updated?

Response: Thank you for pointing out this omission. Indeed, data on access to health facilities, work burden, physical activity, pre-pregnancy illnesses, food and dietary characteristics, psychosocial characteristics, and some of the reproductive and obstetric conditions were gathered at inclusion. We have clearly mentioned all in the revised manuscript (Page 7, lines 1, 4,

7, 10, 12, 18, 24, 28, and 31; Page 8, line 8; Page 9, lines 7, 9, and 12). Concerning the timing of the collection of variables extracted from the KA-DHSS database, the surveillance site updates the database every six months except for wealth index. The last update for wealth index was done in 2015. But, as two of the urban kebeles were included into the surveillance site recently, wealth index data was collected in 2017 in these two kebeles. Therefore, for the wealth index, adjustment was made at inclusion when there was a change since the last update. We have described this in the manuscript (Page 6, lines 17-20).

4. Regarding the suggestion for additionally informing on factors associated with undernutrition as a categorical variable: Poisson regression models with robust variance are suitable for estimating prevalence ratios (please see: Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. BMC Med Res Methodol. 2003; 3: 21. DOI: 10.1186/1471-2288-3-21). Such findings could be presented in supplementary files and might be quite informative from a public health perspective.

Response: Thank you for your comment. We did the Poisson regression models with robust variance as recommended. We have described this in the statistical analysis section (Page 11, lines 4-10). Also, we have presented the findings in the main document without adding an extra table (Page 17, lines 1-6; and table 5). Overall, the findings of Poisson regression models are almost similar to the findings of linear regression models. In fitting the Poisson regression models, we have used the following Stata syntax structure for pre-pregnancy BMI (PPBMIcat) and MUAC (MUACcat):

glm PPBMIcat X_1 X_2 X_3…, fam (poisson) link(log) nolog vce(robust) eform

glm MUACcat X_1 X_2 X_3…, fam (poisson) link(log) nolog vce(robust) eform

5. Limitations have been poorly discussed. Very importantly, p-values were mentioned as strong evidence to “diminish the risk of a chance finding” –which is incorrect. Please see: The ASA Statement on p-values: context, process, and purpose. The American Statistician. 2016; 70: 2, 129 PubMed -133. DOI:10.1080/00031305.2016.1154108). Also, authors stated that “we do not believe that the limitations have affected the generalizability of our findings” –could you elaborate on that?

Response: Reading the recommended article, we are convinced that pointing out p-values as strong evidence to diminish the risk of a chance finding is incorrect. Therefore, we have reviewed the limitations of our study as:

"…..As for limitations, MUAC was measured at inclusion, unlike BMI. However, as MUAC is relatively insensitive to change over time, it can safely represent the pre-pregnancy status. Additionally, seasonal variation was not addressed in the dietary diversity assessment. However, agrobiodiversity and food insecurity have been assessed, and adjusting for these variables may account for the bias that can be introduced due to the seasonal variation. Therefore, we do not believe that these limitations have affected the generalizability of our findings. Finally, our study might not have been free of type one error due to the multiple hypothesis testing. …" (Page 21, lines 10-18)

6. Minor observations: please adhere to the International System of Units and do not capitalize kg; table 1 should clearly indicate that BMI is pre-pregnancy; there are still mentions to

univariable/multivariable analysis in the text; the reference category for husband occupation is different in unadjusted and adjusted models in tables 4 and 5.

Response: Thank you. We checked and revised the manuscript for consistent use of the terms unadjusted /adjusted instead of univariable/multivariable as well as the reference categories (Page 14, line 11; and tables 1, 4 and 5).

7. An overall English review would benefit readability of the manuscript.

Response: We did a thorough language check and made several changes throughout the manuscript (partly marked).