Author’s response to reviews

Title: Predictors of poor nutritional status among children aged 6-24 months in agricultural regions of Mali: a cross-sectional study

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Author’s response to reviews:

Reviewer reports:

K. Ryan Wessells (Reviewer 1): Comments to Authors:

The manuscript under consideration is a cross-sectional survey examining the prevalence and predictors of undernutrition (stunting, underweight, and wasting) among infants and young children in Mali. The topic is relevant, considering the high burden of malnutrition in this region, and the relationships between anthropometric indices and health outcomes. However, I have numerous concerns which need to be addressed (see below), before I believe that this manuscript is acceptable for publication. Overall, the level of detail, citation of other sources, and quality of the manuscript need to be improved.

Background:

1. The first paragraph of the background section establishes a nice framework for further interpretation of the present study. However, beginning with "children living in households …", 
the introduction loses its organization and flow. In addition, the background section needs more information on the context (current situation in Mali), and why this research is necessary (limited data exploring associations between outcomes and predictors). I would suggest rewriting the introduction, to include some additional data from Mali (DHS) to explain the framework and justification for conducting this research. For example:

a. Mention outcomes: Stunting prevalence (i.e. malnutrition), under-5 mortality rate, 2 week prevalence of diarrhea (DHS data)

b. Cite studies which have shown an association between outcomes and underlying "causes" as mentioned in the framework. You start doing this in the background, but there seems to be a focus only on diarrhea and pathogens, and not inadequate dietary intake, and other factors you assess in your study.

c. Create justification for your manuscript - objective of studying associations linking outcomes and underlying "causes".

Response: Most of the introduction has been rewritten taking into account the recommendations of the reviewer. Particularly, we added to the introduction the following:

“In Mali, malnutrition is a public health problem as in most countries in sub-Saharan Africa [1]. It is one of the major causes of morbidity and mortality in children under five years of age. According to the 2012 - 2013 Mali Demographic Health Survey [2, 3], the under-five years mortality rate for the five years preceding the survey was 128 ‰ live births. In addition, among the children under five years old, 39 % were stunted (< -2 SD height-for-age); 13 % were wasted, or underweight for their height (< -2 SD weight-for-height); and 26% were underweight (< -2 SD weight-for-age). The Government of Mali and its technical and financial partners have developed and implemented a number of measures to improve children’s health and nutritional status in recent years, many of which emphasize local governance and leadership in pursuit of positive health outcomes. Public health measures aiming to alleviate malnutrition in Mali should also involves identifying its the predictors in order to develop targeted actions. A number of authors in Sub-Saharan Africa, including Ethiopia [4-6], Kenya [7], Ghana [8], Tanzania [9] and Uganda [10, 11] have investigated the predictors of child undernutrition. Although the predictors reported varied according to settings, they included food insecurity and food diversity [4, 6],
child sex and age [5, 8, 10], child’s birth weight [8], parents’ educational level [5, 10], household socio-economic status [8, 9], breastfeeding [12], water, sanitation, hygiene [7, 11] and child health among which diarrhea [5, 8, 12], fever, cough [11]. To our knowledge, no such study has even been conducted in Mali, nor using all the potential predictors of child malnutrition.

We aimed to determine, among 6 – 24 months old children living in rural areas in Mali using a cross-sectional design, the magnitude of the association between immediate (child inadequate dietary intakes and health conditions) and underlying (household and family level: insufficient access to food, wealth, poor water, sanitation and hygiene) determinants and child growth defined using wasting, stunting and underweight.”

2. The information describing the World Vegetable Center is misplaced in the introduction. The information about the project implementation should be in the methods section (study design and participants) - please describe that this is a cross-sectional survey that was part of a baseline evaluation for an intervention study (and cite if it has been described in detail elsewhere).

Response: The information about the World Vegetable Center has been removed from the introduction and added to the methods section.

Materials and Methods

1. Study settings and target population: Too much information, lack of specifics and citations.

Response: This part of the manuscript has been shortened.

2. Study design and population: Were municipalities selected urban or rural? How were the districts and municipalities selected? What were the criteria for "not too far, with the same socio-demographic characteristics and lifestyle?" How were villages selected? How many villages were selected? Was it random sampling, or convenience sampling? Were all households with children 6-24 months in selected villages eligible to participate? What if there was more than 1 child in this age range per household?
Response: This method section has been modified according to the reviewer comments.

3. Since this is a cross-sectional survey conducted prior to an intervention, I do not believe you need to go into as much detail about control and intervention (i.e. is data collected during the census to match intervention and control households useful for your current analyses?).

Response: information regarding intervention and controls has been removed from the methods section.

4. Sample size calculations: You do not need to go into this much detail here, save this information for the intervention outcomes manuscript. You can simply state the first sentence, and mention the sample size per arm (it seems that you did not meet your sample size?). Then you could state this estimated sample size allows:

   a. Sample size would allow you to detect prevalence of stunting/underweight/wasting to with + X% (95% CI)
   
   b. Assumptions about intra-cluster correlation coefficients
   
   c. Power to detect what degree of associations between variables

Response: All text after the first sentence has been removed and replaced by information requested by the reviewer.

5. Assessment of anthropometry: Were measures taken in duplicate? By whom (training)?

Response: MUAC was reassure trice, weight and length were measured twice. This information was added in the methods section.

Data was collected by three-member survey teams, comprising at least one-woman worker. All enumerators were medical doctors or nurses with survey experience, and at least one enumerator in each team had participated to the census. They were all trained and certified for this study.
Was height really measured to the nearest 1 cm (and not 1 mm)? Was height or length assessed?

Response: This was a mistyping. Length of children were measured to the nearest 1 mm. This is corrected in the manuscript.

6. What exclusion criteria were applied to child anthropometric data (i.e. > 6 SD?)

Response: HAZ and WAZ were excluded if the child value was < -6.00 or > +6.00. WHZ was excluded if the value was < -4.00 or > + 6.00. This was added in the statistical methods of the manuscript.

7. Who administered questionnaires?

Response: Data was collected in each household by three-member survey teams, comprising at least one-woman worker. All enumerators were medical doctors or nurses with survey experience. This information was added to the manuscript.

8. Citation for household amenities scores (World Bank, Mali)?

Response: World Bank, Mali, based on Davidson et al, 2000 work. {Davidson, 2000 #63}

9. HDDS - 12 food groups for household dietary diversity score - only 8 are listed; what is the given reference period?

Response: Page 9: 12 different food groups (cereals; roots and tubers; vegetables; fruits; meat, poultry, offal; eggs; fish and seafood; pulses/legumes/nuts; milk and milk products; sugar/honey; oil/fats; spices/condiments/beverages)

10. Did you collect data on maternal parity/gravidity?
Response: We collected principally information on number of children alive for each mother (table 3).

11. Please cite reference for definition of diarrhea.


12. How did you assess quality of complementary feeding? Did you use WHO IYCF indicators, and minimum dietary diversity? If not, why not? Why were only 8/12 items used in the scale you were using? How valid is this indicator for individual young children?

Response: For example, “sugar/honey” is included as a food group for household HDDS. As an indicator of socio-economic change, the inclusion of sugar or honey in a household’s diet tells us something about their ability to access/purchase food. In contrast, sugar and honey are not included as a food group in the list of food groups included in an IDDS indicator for children, because this food group is not an important contributor to the nutritional quality of a child’s diet. {Swindale, 2006 #65}

The table below provides the differences between HDDS and IDDS.

<table>
<thead>
<tr>
<th>HDDS food groups (score: 0 – 12) household</th>
<th>IDDS food groups (score: 0 – 8) children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>Cement products</td>
</tr>
<tr>
<td>Roots and tubers</td>
<td>Fruits</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Meat, poultry, offal</td>
</tr>
<tr>
<td>Fruits</td>
<td></td>
</tr>
</tbody>
</table>
Eggs
Fish and seafood
Pulses/legumes/nuts
Milk and milk products
Oil/fat
Sugar/honey
Miscellaneous
Grains, roots or tubers
Vitamin A-rich plant foods
Other fruits or vegetables
Meat, poultry, fish, seafood
Eggs
Pulses/legumes/nuts
Milk and milk products
Foods cooked in oil/fat

13. Statistical analyses: please go into more detail about statistical procedures used for the multi-stage random sampling design. It seems like the background situation in Sikasso and Mopti is very different. Was this taken into account?

Response: For each participant included in the study a probability of sampling was computed based on its region/village. This probability served to determine a weight was computed taking into account the complex sampling design, and survey data analyses procedures of the Stata software were used. Statistical analyses were adjusted on the region.

14. Did you examine the 4 outcomes as continuous variables vs. dichotomous variables (to have increased power to detect differences)? If not, why not?

Response: As we were mainly interest in the prevalence of stunting, wasting and underweight, only dichotomous variables were used as outcomes.
15. Correct: using either WHZWHO

Response: This has been changed to “using both WHZWHO and MUAC”.

16. Please provide citation for MUAC cut-offs


17. Why did you conduct a multivariable analyses? (please note: multivariable, not multivariate).

It seems like bivariate analyses would adequately address your main objective, since you are not trying to build a predictive model (you are trying to identify potential predictors). Through larger multivariate models you are only able to learn if the potential predictor variable is significantly related to the response variable in the context of all of the covariates added to the model. In addition, the results are uninterpretable, because there is likely a high degree of collinearity between your different variables (what does "checked" and "handled" mean?)

Response: As bivariate associations may be hampered by confusion, we thought it may be interesting to provide multivariable associations. As the reviewer point out, there is a risk of collinearity, leading to artificial non-significant association. However, the potential predictors which are significant in these models really are, and we believe that these data are interesting for the reader. We may suggest providing table 5 as supplementary information.

18. Ethical considerations: A large proportion of the population was illiterate. How did you obtain informed consent (i.e. fingerprint, presence of a neutral witness)?

Response: At last one survey team was able to speak the local language and to translate the information about the purpose of the study.
Results:

1. Flow diagram: A flow diagram would be helpful: number of households consented, number enrolled, number with main outcomes.

Response: As we already have five tables and one figure, and as this information can be delivered in one sentence, we felt that it was not necessary to use a figure for that. “Overall, 1897 households were invited to participate to the study, with a 95.3% response rate; 1808 households took part in the study. Due to missing values in anthropometric variables and main outcome variables, analyses included 1764 households with 959 boys and 856 girls and their mothers.

2. How is inadequate food provision defined (please add to materials and methods)?

Response: It is a combination of responses to nine questions with a scoring scheme. The reference {Coates, 2007 #47} (available as a pdf file on internet) is given for the reader.

3. Presentation of data in text vs. tables - the reporting of the data in the text could be tightened (made less wordy….reduce "one third… one third….", etc.)

Response: the description of the results is now more succinct.

4. 40% of children had reported diarrhea. This seems very high. How does this compare to DHS data? The specific data about diarrhea seems unnecessary, as it is not used in your analyses and does not contribute to your conclusions.

Response: Specific information on diarrhea was removed from the results text.

5. "Prevalence and risk factors of underweight…” only provides data on prevalence. Please adjust sub-heading appropriately.
6. WHZ is missing from initial list of variables (pg. 13, line 19); missing units of data presented (SD).

Response: WHZ has been added to the list of variables, as well as the units of data.

7. Why are 95% CI given for prevalence of underweight/stunting/wasting but not severe forms?

Response: The confidence intervals are now provided for severe forms of malnutrition traits.

8. Define "chronic" and "acute" malnutrition (or preferably, use terms "stunting", "wasting", etc.).

Response: chronic and acute malnutrition were replaced by stunting and wasting in the text.

9. Why are P values given for household indicators, but not child level characteristics (be consistent).

Response: p values are now provided for child level characteristics.

10. Tables should be numbered in the order in which they appear in the text.

Response: Order of the tables were changed.

11. How did region impact your results? Were their differences in associations by region?
Response: There was no interaction between predictors and outcomes for region, therefore, the multivariate analyses were adjusted for region.

Discussion:

1. How would seasonality impact your results? Please describe the season in which the survey was conducted. Discuss the impact that seasonality could have on the relationships between child nutrition and predictors.

Response: Seasonality is reported to impact on the prevalence of wasting {Wright, 2001 #101}, particularly in regions where food accessibility depends on harvest. In our study, data collection was performed from January to June, which correspond to the post crops period, with the highest food availability. Therefore, the impact on seasonality on the prevalence of wasting was

2. I do not find the comparison of WHO indicators for anthropometry with other countries that helpful.

Response: this part of the discussion was removed.

3. Was food security associated with dietary diversity? You posit this in your discussion, but both parameters were tested, so you could evaluate this.

Response: Food security was not associated with dietary diversity in our study.

4. Why do you think maternal factors were not associated with WHO indicators?

Response: Probably because of the younger age of children and the economic constraints, which are the major factor driving malnutrition in a setting where there is not enough variability among maternal characteristics. For example, 1.1% of mothers attended more than primary school, 73% were housewives and more than 80% were aged under 34 years.
5. Maternal parity/gravidity: Is it that she has given birth to five or more children (or still has five or more children alive)? This could be a big difference in the context of high U5 mortality.

Response: We mainly obtained information on the number of sibling, and this is taken into account in the analyses.

6. Large family size - could be related to lower SES, less access to family planning, maternal age? Instead of only financial constraints associated with having more children?

Response: The results were independent of the socio-economic status and the maternal age in the multivariable model.

7. "rending" - should be "rendering"

Response: This misspelling has been corrected.

8. Do you have reason to believe that the children in this study were exposed to toxins and air pollutants? (i.e. explanation for stunting in boys). If so, link it back to your study population (i.e. fuel sources for cooking?).

Response: We have no reason to believe that the children were exposed to air pollutants or toxins. Most of the cooking was performed in an open environment, and they live in an environment where there are no industries.

Tables:

1. Definition of vegetable intakes for the mother? I am surprised to see them so low, in populations where the typical diet is a staple food with a vegetable based sauce?
Response: There was a particular attempt to define “vegetables” to participants. May be the low response is related to a misunderstanding of what is a vegetable.

2. Sex of child: male/female vs. boy/girl
Response: Sex of the child is now boy versus girls in all the tables and in the manuscript.

3. Child still breastfed: Having "yes" first would be more consistent with other variables.
Response: Only a yes row is now displayed in the tables were appropriate (only yes or no responses available).

4. Define IDDS class.
Response: IDDS class was define as footnote for table 1

Carin Napier (Reviewer 2):
The study is very relevant and important when considering the malnutrition rate in Africa and Sub-Saharan Africa. The considerations of various factors impacting on malnutrition give a wider view of the issues with regards to malnutrition, hunger and food security.

The abstract summarizes the study and the outcome and the background give a clear indication of the origin of the study and the context.

Recommendations:
Add the ethics clearance number to the Ethical Consideration section, explain also in this section how anonymity was ensured.
Response: The ethics clearance number is N°2016/44/CE/FMPOS. This has been added to the manuscript.

Please give a little more discussion around the variables mentioned in lines 58 and 59

Response: We guess that the reviewer refers to breastfeeding, as no page number is given with the line numbers. We added the following in the discussion section. “Being breastfed was not associated with malnutrition in our study, contrary to other reports. As our study population include children at breastfeeding age (6 – 24 months), our results concerning breastfeeding should be interpreted with caution.”

Tables general comments:

The sample size in (n=?) should be indicated in each of the sub-sections in the tables.

Response: Sample sizes are now indicated in each table and in the figure.

A footnote is required with regards to the p-value and what is seen as significant in each of the tables

Response: The significance level was set at 0.05. This information is given in the statistical methods section. It figures now as footnotes for each table.

Table 1:

The headings for each of the Household Characteristics, needs a data indicator, in the case of the 'Months of inadequate household food provisioning' the results are indicated in %. The 'household dietary diversity score' and 'Household amenities score' are presented in Mean and range, this should be indicated.
Response: An indicator was added to each heading in table 1.

The yes/no questions further down need a 'yes' only as the difference is automatically a 'no' if it adds up to a 100%.

Response: Only a yes row is now displayed in the table were appropriate.

The indicator 'Garbage in trash dump outside the household' - change to trash dump/bin

Response: Trash dump/bin replaced ‘garbage in trash dump outside the household’ in the table.

The mothers characteristics is in mean age and range and then the rest in %

Response: An indicator was added to each heading in table 1.

Table 2, 3 and 4:

Indicate sample size numbers (n=?) in the heading for the full group and each of the nutritional status categories

Response: The sample size was added at the head of the tables.

The font type in the table is inconsistent

Response: This issue was fixed.

The same Yes/No answering should be applied in this table where adding up to a 100%

Response: Only a yes row is now displayed in the table were appropriate.

Table 5:
Indicate sample size numbers (n=?) in the heading for the full group and each of the nutritional status categories

Response: The sample size was added at the head of the tables. As the table displays multivariate logistic regressions, data were available for all the variables in the table.

The data under each nutritional status category is measured in %, remove the % from the headings and indicate if it is Mean and range etc.

Response: The percent character was removed from the titles. It was added in the title that the values in the tables are odds ratios and 95% confidence intervals.

The font type in the table is not consistent

Response: This issue was fixed.

Figure 1:

Indicate sample size numbers (n=?) in the heading for the full group and each of the nutritional status categories

Response: Sample size was added to the figure, as well as a mention that data were available for the same number of participants for all the anthropometric indicators.

Add data labels at it will make the graphs easier to read

Response: Data labels were added to the figure.

Add a title to both axes
Response: Titles were added to both axes of the figure.