Author's response to reviews

Title: The association between travel time to health facilities and childhood vaccine coverage in rural Ethiopia. A community based cross sectional study.

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Author's response to reviews: see over
Dear Dr Nicole,

Thank you for sending the detailed reviewer’s comments. We have responded to all of the comments point by point below and have also attached the revised manuscript. We believe the paper has been strengthened substantially and we look forward to your feedback.

Kind regards,

RESPONSE TO REVIEWERS’ COMMENTS

Reviewer 1

Major compulsory revisions:

1. The Results section of the abstract states that 77% of children were vaccinated with DPT3 vaccine in the last five years. This contradicts information presented in table 1-3, where about 93% of children appear to have completed DPT3 vaccine. There are similar inconsistencies for BCG and measles. The problem seems to be due to the fact that missing data were not accounted for consistently throughout the manuscript.

   We agree with the reviewer. All analyses were conducted excluding missing data. We have now made this clearer in the abstract on page 3 and in the text on page 10. “In the children with complete records 93% (602/648) of children had been vaccinated with Penta3 vaccine in the last five years before the survey; 97% (719/739) received BCG and 82% (564/690) Measles.”

2. Main analyses are based on logistic regression. This is a suboptimal choice when the outcome of interest is “not rare”, because the odds ratio gives a biased estimate of the risk ratio in these situations. To avoid any confusion, the authors should use a more appropriate alternative such as log-binomial regression or Poisson regression with robust standard error estimation.

   We agree with the reviewer that this is an important point. We have now re-analysed the data using Poisson regression models with robust standard error estimation and have reworked table 2 and 3. The effect of travel time is still significantly associated with immunisation coverage for all vaccines.

3. According to the EPI immunization schedule, primary vaccination should be completed by age 12 months; therefore focusing on immunization coverage rates in children aged 12-59 months is somewhat misleading. It is unclear why the author did not focus on vaccination delay, for instance, by reporting proportions of children vaccinated with vaccine X by the age of 2 years (or any other relevant age). At the very least, this issue should be thoroughly addressed in the discussion section on study limitations.

   We agree with the reviewer on the importance of the age group of 12-23 months and also the importance of reporting on timeliness on the vaccination. However, due to sample size restrictions we were unable to restrict the study to 12-23 age group. We were also
unable to report on timeliness of vaccination due to poor maternal recall. These are limitations of our study and we have now included this information in the Discussion section on page 12, paragraph 5 of the revised manuscript.

**Minor essential revisions:**

4. The first reaction when reading the background section of the abstract is that the introductory statement is untrue, because many studies have assessed associations between access to health care and childhood immunization coverage. It is correct, however, that less research has been conducted in truly isolated areas. The authors should consider better emphasizing this point (e.g., by specifying “in remote communities lacking modern transportation and communication systems”).

   We agree with the reviewer that this is not clear. We have now changed the sentence in the abstract on page 3 to read “in remote communities that lack motorised transport”.

5. On page 5, in the Methods section, it is unclear whether polio1 is given at birth or at 6 weeks.

   We agree with the reviewer that this is unclear. There is no birth dose of polio, polio1 is given at 6 weeks of age. We have corrected these errors on page 5 of the manuscript.

6. On page 6, in the Data collection section, eligibility criteria should be described in more details (e.g., only children present at the time of the survey?).

   We agree with the reviewer that this information is missing. We have now changed the sentence to read “Trained data collectors visited households and identified eligible children present at the time of the survey”.

**Reviewer 2**

**Major essential revisions**

1. The main concern I have is for the discussion last paragraph – arguably the most important in the article (page 12). The authors state that: “High levels of vaccination coverage can be achieved in remote area (“s” is missing) for children with poor access to health facilities, at least in early infancy.” This is not a true generalization. Actually it is very hard to achieve high coverage in remote areas. The point of the article (as I understand it) is that higher coverage can be achieved if access to health services is improved by reducing distances/travel time for mothers to reach vaccination sites. The next sentence: “However, problems with access to other infant vaccines remain” is confusing and does not logically follow the previous one. The sentence could usefully be deleted. The next sentence: “Outreach programs and supplemental immunisation activities such as national immunisation days should be considered for other vaccines such as DTP and BCG” would be more accurate if it generalized for all vaccines e.g. “Where appropriate, outreach programs and supplemental immunisation activities should also be considered for raising coverage”.


We agree with the reviewer about these points and have revised these sentences in this final paragraph: “Vaccination coverage can be improved in remote areas by improving access and reducing the travel time to health facilities. Supplementary immunisation activities may also be contributing to improvements in immunisation coverage and reduction in inequalities. Where appropriate outreach programs and supplemental immunisation activities should be considered for raising coverage in remote areas.”

**Minor essential revisions**

2. The age range of infants surveyed was 12-59 months. I assume this is because the ongoing survey that this was a part of wanted to include this age-range. Normally coverage surveys restrict the age range to 12-23 months. By extending the range to 59 months, the study has included late doses (outside the scheduled age) in its estimate of coverage – this has the effect of inflating coverage by including late doses. While this does not invalidate the study, it might conceal a real difference in the age at which infants are getting immunized – do mothers, for instance, travel more willingly with a younger or alder child? In terms of vaccine coverage levels, it is actively misleading, but that is not the focus of the study. It would be good to see a brief acknowledgement of this point in the text.

The reviewer is right to point out the importance of restricting the age range to 12-23 months. However, as discussed above in the response to reviewer 1 point 3 we used the 12-59 month age range because of sample size limitations. We have now added this information on page 13 paragraph 4 of the revised manuscript “our coverage data are calculated using children aged 12-59 months and are likely to be higher than other studies and the DHS which use younger children aged 12-23 months.

**Some minor points:**

   We agree with the reviewer and have made this change on page 5

4. Page 4 line 15 mins should be written in full i.e. minutes.
   We agree with the reviewer and have made this change on page 4

5. Page 5 the immunization schedule is not described in generally accepted terms. What is called DTP is actually “DTP-containing vaccine” or “pentavalent vaccine” as it contains five antigens.

   We agree with the reviewer and have changed the term DTP to pentavalent throughout the manuscript.
6. Polio vaccine should be described as oral polio vaccine (OPV) to distinguish it from IPV. It would be appropriate to mention here that OPV and measles vaccines are also delivered by supplemental immunization activities. We agree with the reviewer and have made this change on page 4.

7. Page 11 line 16 too many “to”s
   We agree with the reviewer and we have corrected this error.

8. Page 12 Competing interesta should be competing interests.
   We agree with the reviewer and we have corrected this error.

9. References: some inaccuracies eg ref 11 and ref 20. The protocol is to name only six authors and to state “et al” for any more than 6. This is not adhered to.
   We have checked this and we want to confirm that we have adhered to BMC guidelines. In the ‘Instruction for authors’, here is what it says about references: “References should contain all named authors, regardless of the number. The term ‘et al.’ should not be used.”

Reviewer 3

Major revisions
1. The authors should show if the study population did not change location in the last five years and what steps they took to adjust/ control for this.

   This was a cross sectional study and travel time were assigned at the point at which the mothers were interviewed and there was no ongoing tracking of migration. Thus there may have been some misclassification of exposure status. This is a limitation of our study and we have now included this information in the Discussion section on page 12 paragraph 5 of the revised manuscript.

2. The validations of the various speeds for different movements, walking through water bodies should be shown.

   We assigned speeds for different types of movements, using the basic rule of Naismith [1] which states that a person can walk a speed of 5 km/h on a flat road, but 1 hour needs to be added for every 600m of ascent. Our overall model was validated as described in our previous paper [2] by comparing the mean and standard deviation of estimated travel time with the mean and standard deviation of the reported travel time obtained from the 40 villages. However, we did not replicate the validation of the speeds for different types of movements in our study. We have added the following information into page 8: “Validation of the model was described in detail in our previous paper [2]. In brief, reported travel time from 40 village centres were obtained and compared with estimated travel time. Mean reported and estimated travel times were very close (mean 73 standard deviation [sd] 46 and mean 67 sd 40 minutes respectively)”
3. The locations of the various kebeles (7) to the health facility should be shown and the average distance be used since the primary outcome of the study was the effect of distance on immunization.

We agree with the reviewer. We have revised figure 3 to show the boundaries of each kebele as well as each health post. We have also added the following information into page 10 of the revised manuscript “The average travel time in the kebeles ranged from 37-81 mins (Figure ).”

**Minor revision**

4. The type of random selection method should be stated.

We agree with the reviewer and have now added this information on page 3 on study design section: “208 households were randomly selected from a list of the rural kebele households supplied by the HDSS using a computer generated sequence”

5. The methods should be more specific about methods of selection of the participants.

We agree with the reviewer and have now added the method section in the abstract to read: “208 households were randomly selected from each kebele. All children in a household were eligible for inclusion if they were aged between 12-59 months at the time of data collection.”

6. The statistical test for the association and the p value should be stated

We agree with the reviewer and have now changed the methods section in the abstract to read: “Analyses were conducted using Poisson regression models with robust standard error estimation and the Wald test.”

**References**
