Author's response to reviews

**Title:** Factors influencing place of delivery for women in Kenya: an analysis of the Kenya Demographic and Health Survey, 2008/2009

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**Author's response to reviews:** see over
Cover Letter

Ref: Revised Manuscript

I wish to submit an edited version of my article based on the comments received from reviewers. I have described below how each comment has been responded to in the manuscript for each reviewer.

Reviewer 1.

Background

This section needs to be improved to make your argument come out strongly in terms of the contribution of your paper to this area of maternal health. The authors could start by reviewing some key articles from studies done in similar developing country settings to enable them identify existing gaps that their study seeks to fill. Without this, the paper does not come out strongly as it should, despite the fact that it seeks to make significant contributions by looking at delivery care among women in Kenya.

Thank you for pointing this out. Since we want to bring this contribution out clearly, we have given examples of the individual, family, and community factors that are known to contribute to determining place of delivery from the literature, and have also presented some studies that have studied this area in different parts of Kenya in paragraph two of the ‘background section’.

Methods section

2. The authors have based their analysis on the most recent delivery for each mother. It would be important to explain why they left out, from the analysis, previous births given the influence they could have on the most recent delivery

We have considered the impact of parity and hence of the number of previous births. We decide not to include data on more than one birth for each woman within the analysis for two reasons; first, the likelihood of strong correlation between the data for consecutive births within a woman with the same factors determining place of delivery for each pregnancy. Secondly, difficulties in recall and associated biases are likely to be a problem for earlier pregnancies. For those reasons, we have selected for analysis data on the most recent delivery only.

3. It is important that the authors mention which KDHS questionnaires were used to come up with the research questions and possibly state how these questions were asked

We have mentioned the questionnaires used and pointed readers to the site under measureDHS where the questionnaires are available for review in paragraph 1 under study population

4. It would be appropriate if the authors cited related literature reviewed to help them identify the 17 explanatory variables that have a potential to influence place of delivery

We have updated our references in the methodology section to reflect the literature reviewed that informed variable selection – references 9 – 14, 17. We did not limit selection to those in previous studies but went through the variables in the dataset to selected additional variables that were also likely to determine place of delivery.

5. Did the authors also explore for collinearity between parity and age of the mother?

We checked for collinearity for all variables including that between parity and maternal age and there is high correlation between the two. Maternal age is significant when parity is removed from the final model but it becomes insignificant (p=0.48) once parity is reinserted in the model. Parity remains highly statistically significant (p<0.001) with or without maternal age in the model so we retained parity over maternal age.

6. It is not clear what the perfect sample for this paper is and how it was arrived at. It would be necessary to clearly state in the ‘methods section’ what the sample for this particular paper is
We have improved on the description of the sampling strategy in the Manuscript in the first paragraph of the study population section. According to the KDHS report, the sample was constructed to allow for separate estimates for key indicators for each of the eight provinces and for urban and rural areas separately.

**Results section**

7. I am a bit confused by the reporting of results on the first paragraph of this section. Are the authors reporting results for all the births to women aged 15-49 in the 2008-09 Kenya DHS? In the ‘Methods section’, the authors mentioned that the analysis will focus on the most recent birth for each woman, what has changed?

The reviewer is right that the first paragraph of our result section gives a short overview of the number of women in the complete dataset, and then the number giving birth in the last 5 years, to set the context for our analysis of the most recent birth for these women. We have altered the methods section (paragraph 1 under study population) to clarify these numbers and our study population.

8. The finding that Somali and Kalenjin women were more likely to deliver in health facility is contradicted by another finding that says women from North Eastern and Rift Valley Provinces were less likely to deliver in a health facility. From my understanding of Kenya, majority of Somali and Kalenjin women live in North Eastern and Rift Valley Provinces respectively. Did the authors try to understand why this finding was as it is? If yes, what were the reasons? Do the results of the Somali women particularly compare to results of previous KDHS findings? For instance, what do the results 2003 KDHS show about this group?

Historically these ethnic groups have traditionally lived in these regions but now there are a lot of other tribes who live in these provinces as well. There is no correlation between ethnic group and region of residence (Pearson’s r = -0.056). The differences could also be partly explained as arising from an ecological effect given the different non homogenous occupation of respective regions of Kenya by specific ethnic groups.

9. It is not surprising that majority of the women mention distance as a barrier to health facility delivery. Did the authors try to distinguish between distance in terms of ‘actual kilometers to the health facility’ and ‘means to access health facility at the time of labour’?

The questions to the mothers were not designed to separate between distance in terms of kilometres and means of access. These two were combined together and so it was not possible for us to separate these two during analysis.

10. Results of the multivariate model show that Kalenjin, Kikuyu, Meru and Somali women were likely to deliver in a health facility, why is this so?

This can partly be explained by the reference groups we use and hence these four groups are likely to deliver in a health facility when compared to the Luhya women. A qualitative study is also needed to provide insight to the significant differences in place of delivery among the difference ethnic groups and bring out the specific socio-cultural practises that play a role. Please also refer to response 8 above.
Reviewer 2.

1. Provide a timeframe and a location (annually in low-income countries…)
   We have provided respective dates and timeframes in the manuscript (1st paragraph of background section)

2. Which deaths? (Reducing maternal and neonatal deaths…)
   We have clarified the type of deaths. (1st paragraph of background section)

3. Just qualified midwives? There are multiple cadres of skilled attendants. Why the focus on midwives?
   The word “midwives” has been changed to “skilled workers” to capture the multiple and wider workforce that can provide skilled care to a woman during childbirth. (1st paragraph of background section)

4. This sentence reads like the “health centre intrapartum care strategy” is the only means of reducing MMR and NMR. Perhaps phrase it as "A key strategy to reducing maternal and neonatal mortality is the health centre intrapartum care strategy. This strategy…"
   Thank you for highlighting this. We have edited the sentence to reflect our belief that "health centre intrapartum strategy" is a key strategy but not necessarily the only one. (1st paragraph of background section)

5. Perhaps identify a few. If the purpose of this paper is to (hopefully) showcase new findings from Kenya, what were the reasons that authors have previously known about? It will help to highlight what your findings have added to the literature.
   We have added under second paragraph of the background section details of factors that have been associated with place of delivery in Kenya from the literature and highlighted that these studies have focused on small regions of Kenya. Once study was conducted a while back (2000) and the need for a current evidence that uses a nationally representative dataset controlling for a wider range of factors is needed.

6. Interesting statistic. Is it perhaps related to better means of identifying and documenting maternal death? That’s a marked increase. Are there any other factors (aside from the minor decrease in facility deliveries) that may have impacted maternal deaths?
   These figures could be explained in part by better data capturing recently. However, we could not find any evidence to support this, and given that the estimates have wide uncertainty margins, the message is more of the consistently high mortality rates over the years than the trend. We revised the paragraph 3 under background section to reflect this understanding and to clarify that low health facility delivery partly (and not necessarily wholly) explains the high maternal mortality rate in Kenya.

7. Although above you indicate that there are multiple individual, household, and community factors interacting to determine place of delivery. Distinguish that this knowledge is from other countries, if that is the case.
   I'd also break this sentence up into two.
We have edited our text to reflect that this factors are from studies from a across a range of developing countries and not necessarily from Kenya. We have also broken the sentence to make it easy to read and follow. *(Paragraph 3 under background section)*

8. Perhaps explain that the purpose of this instrument is to provide GPS coordinates for your distance analysis. We have explained the purpose of the GPS data in this article in the last paragraph of the background section)

9. Capitalize or keep your sub-headings in this format throughout. The format of the headings and sub-headings has been checked for consistency throughout the manuscript

10. Run-on sentence. Break into two to read more clearly. The sentence in first paragraph under methods section has been broken into two but also edited, based on reviewer 3 comments to facilitate easy reading.

11. Either make lower case or ensure capitalization throughout. See comment 9 above. We have ensured consistency in case/capitalization throughout the manuscript as well.

12. If your intention is to determine WHY women choose to deliver in a health facility, why would you lump women en en route to a health facility with home delivery? The women en route had made the decision to deliver in a facility, they just didn't make it there. If this number is too small to effect your findings, I recommend that it's stated as such, or at least provide a line of clarification as to why you lumped the two together.

   Given that this number is very small (1.14% (*n*=45)), we decide to group it with home deliveries as this may reflect women who attempt to deliver at home and only decide to go to a health facility much later. We have given this rationale in the manuscript in first paragraph under outcome and explanatory variables

13. I'd add in a heading for "Univariate Analysis" as you have done below for multivariate analysis. We have added headings for "univariate and bivariate analysis where appropriate.

14. It would also have been interesting to see if the quality of roads made an impact. A 5km+ distance on a paved road that is direct is very different than 2km on a poor, unpaved road that is not direct. There is likely to be a large seasonal impact, as an unpaved road during rainy season may become impassable. That your group didn't look at seasonal effects of distance is also a limitation.

   Thank you for highlighting these two limitations. They have been added to the second paragraph under strengths and limitations.

15. I think this point needs to be expanded upon, and not only insofar as the available variables for exploration is concerned. Your whole research question, in my opinion, is one that would be best answered through qualitative research. If there was a qualitative piece that was expected to follow this research, I think that would be enormously beneficial.
We have edited out manuscript to emphasise that a qualitative study would better explore some of the findings as the last sentence under the strengths and limitations section.

16. Where is this study from?

The cited study was from Kenya and the name has been inserted in first paragraph under Result set in context

17. What other literature supports these conclusions? There is an abundance of literature about the impact of emergency transport schemes, which would be relevant here.

We have cited a recent systematic review by Lee et al (2009) showing that emergency community referral/transport systems can increase rates of skilled birth attendance in second paragraph under Results set in context.

18. These suppositions would be supported if you were able to draw on existing literature here.

Thank you for pointing out this. We have provided evidence from existing literature on the empirical studies looking at costs that accrue to a mother increasing the opportunity cost of a health facility. See paragraph three under Results set in context

19. I think this point is really important and could do with another line or two. Behaviour change literature also suggests that personal testimonies from others is a very influential source of information. Because maternal mortality is relatively rare, many women deliver without complications, and the experiences of these women and a woman’s own deliveries, from what I have come across anecdotally and also in the literature, has a huge impact on the perceptions of the necessity of facility delivery.

We provide a summary of the effect of perception and have pointed readers to some studies that have looked at the effect of perception of use of health facility delivery and what shapes these perceptions including experiences of their own or at health facilities. This is an important aspect of health facility use during childbirth. See fourth paragraph under Results set in context

Reviewer 3

1. There are a number of the points the authors need to revisit in trying to revise the paper. In the “Study population” section, the authors indicated that the KDHS “involved randomly selected households across Kenya and all women aged 15-49 years in each household and all men aged 15-49 in every second household selected were interviewed …” This is poor and inaccurate description of the sampling strategy for the 2008/09 KDHS.

We thank the reviewer for pointing this out. We amended our description in paragraph 1 under Methods to accurately reflect sampling technique as described by measureDHS.

2. Under “Statistical methods”, the authors’ use of the word “univariate associations” is inaccurate as univariate analysis simply refers to basic description of a single variable (frequency distribution of single variables) as shown in their Table 1. This error is carried throughout the paper. At the bottom of page 4, the authors noted “In univariate analysis, all explanatory variables were significant predictors of place of delivery …”

We have made this correction and checked that we have labelled univariate and bivariate analyses appropriately.
3. Also, the authors should have used simple Pearson’s Correlation matrix across all variables to identify which variables may be highly correlated rather than simply checking on a few to assess collinearity. For instance, one would expect higher collinearity between ethnic group and region than between ethnic group and religion. Looking at the latter could not help one identify the former.

We have conducted Pearson’s Correlation matrix across all our variables. There is a strong correlation between residence and wealth, with residence being statistically significant in a final model where wealth is not included. We have therefore presented these results separately as well. We are satisfied with our final model and excluded variables are not due to a correlation with any variables remaining in the model.

4. Some of the numbers in Table 1 do not make sense. For instance, their numbers show there were 2,983 (73.2%) in urban areas versus 1,091 (26.8) births in rural areas. This is highly improbable for a country like Kenya where only 25% of the women in the 2008/09 KDHS lived in urban areas. Even if one assumes there was a typographical mistake with urban being mis-labeled rural, the numbers also do not match. In the KDHS report, there were only 1,074 births in urban areas in the 5-year period preceding the 2008/09 survey. So it is not possible to have more births in urban areas when one selects only one birth per woman. Several of the variables also have this problem. With respect to birth order, 1st delivery is reported as 887 compared to 1,310 in the report and one would not expect much change in this particular indicator. This raises questions as to whether the univariate and bivariate analyses in tables 1 and 2 respectively used weighted or unweighted numbers.

Thank you for pointing out the typographical error. We have corrected the rural/urban mislabelling in Table 1. We have updated the tables with correct figures from analysis based on weighted numbers. I wish to clarify that the figure 1310 quoted the 1st delivery under birth order in the KDHS report refers to first delivery of all deliveries within the five years preceding the survey but for our study we have only analysed the most recent delivery for each woman which shows that only 845 women had their first delivery as the most recent delivery with the difference (465) having had other deliveries after their first. In total there were 3977 most recent deliveries with 822 in urban areas and 3145 in rural areas.

5. The definition of the variables may also be very problematic. For instance, the relationship between wealth quintile and place of residence may simply result from the wrong application of the wealth quintile variable in the KDHS dataset uniformly to urban and rural areas. Not only does this distort poverty measures in urban and rural areas, but it also affects comparisons across the quintiles. Very few rural households appear in the higher quintile brackets and very few urban households appear in the lower quintile brackets. It is much better to use the same indicators in the variables to reconstruct such variables separately for urban and rural areas. This also applies to the measure of distance. The household GPS data used displaced household coordinates differentially between urban, rural, and sparsely populated areas of Kenya to maintain confidentiality of the respondents. However, the analysis used the same cut-off for all women irrespective of their place of residence. Not only will such a measure be highly correlated with place of residence, but it is unclear the differential displacement of household coordinates affects the observed association between distance to a health facility and use of health facility for delivery.

We have looked at the effect of distance analysed in two alternative ways, both categorised into three groups. The first analysis considered distance as near, middle, far with rural as <2, 2-5 and >5Kms respectively and urban as <1, 1-3, and >3Km respectively reflecting the differential displacement for rural and urban households (results not shown in the paper). We felt that this approach turns an objective measure of distance into subjective categories different for rural and urban areas with different arbitrary cut-off points for each. Our alternative approach analysed distance data using the same cut-offs for urban and rural areas which we felt retains some degree of
objectivity. We used distance in both these forms in the multivariate models but it remained non-significant i.e. the message was the same.

Definition of the wealth index: This is a fundamental question that continues to be debated about what the best way to construct wealth quintiles for urban and rural areas is. DHS data does not capture data that can be used to categorise wealth sufficiently and appropriately and appreciate the different manifestations of poverty and wealth in rural and urban populations. Trying to reconstruct the wealth quintiles differentially from the data collected will be highly subjective. We use wealth quintile as calculated across the whole population categorised in a standard way across the whole population.

For both distance and wealth, we feel that our approach addresses more directly the effect of these factors across the whole population rather than looking at the impacts of relative wealth or distance within urban and rural communities. We have addressed the potential for correlation between wealth and distance and urban/rural residence by looking for collinearity and looking at effects of correlated variables individually.

6. Some of the conclusions may also require re-visiting. It is unclear what is meant by “Since misclassification of distance is likely to be non-differential with respect to place of delivery, we expect the effect to be a reduced strength of effect of distance”. The inference that the effect of education may result from the subjective valuation of the importance of health facility delivery among women with secondary or higher education led the authors to recommend targeting “women with low formal education with health education around pregnancy and childbirth” so as to “improve their knowledge, perception and valuation of health facility delivery …”. The KDHS report suggests that for half of women with no formal education, lack of transport and facility being too far is their main reason for not delivering in a health facility. The reporting of health facility delivering not necessary (which is one response category that can be addressed through education programs) did not vary by educational status.

The conclusions have been revised accordingly to better reflect our findings results. We have edited the Strengths and limitations section (paragraph 2 of the section) to accurately state that the differential displacement for distance measurements in urban and rural areas means there is more inaccuracy in the rural measurements but that we have adequately considered the effects on our analysis of any correlation between distance and site of residence.

It is agreed that education did not predict whether women would say health facility delivery was necessary or not. Therefore, we agree that health education aimed at the 20.5% of women who thought health facility delivery was unnecessary need not target those with lower levels of education. This has been altered in the article. We have edited to argue that health education need to be carried out together with improvement of experiences at health facilities and with efforts to remove other barriers as well so it reflects a need to target women across the board.