Reviewer's report

Title: Why are children not vaccinated against measles? A cross-sectional study in two Nigerian states

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Reviewer: Arnaud Le Menach

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The authors performed two cross sectional surveys and carried out focus group discussions in two states in Nigeria (Bauchi and Cross-River) to estimate measles vaccination coverage, and understand the reasons for non-vaccination. The authors found that vaccination coverage was low especially in Bauchi state, and highlighted the main factors for non-vaccination. The study is interesting, especially as the authors used quantitative and qualitative approaches for a direct impact on decision-makers. However I have a couple of comments below (Major Compulsory Revisions):

Introduction:
1. 1st paragraph: Childhood mortality related to malaria (and to some type of pneumonia or diarrhea) will not be reduced by vaccination. The authors should not make this association.
2. Overall there is some context missing around the measles situation and its vaccination in Nigeria. I would suggest to reformulate the introduction:
   a. Focus the first paragraph on measles disease situation worldwide and in Nigeria (morbidity, mortality currently and over the last years, where is malaria in Nigeria, is it only a childhood disease or do we observe outbreaks in older population as well...)
   b. Add a paragraph about measles vaccination in Nigeria (what is the protocol, for whom, when is it distributed, how)
   c. Add a paragraph about what is known regarding vaccination and barriers to vaccination in Nigeria, and why this study is needed. A lot of publications have been done on measles vaccination in Nigeria, and it would very helpful to understand the rationale for this study.
3. The first part of the last paragraph is more related to the selection of the study sites and should be moved to the method as explained below.

Method:
4. From a formatting perspective I would suggest to follow a standard way to present the methods:
   a. Study population and site (some of it is in the introduction, but what is the measles situation in those two states, why were they selected, what is the study population?)
b. Survey design  
c. Data collection  
d. Data Analysis  

5. More information should be provided about the sampling design (how was the sampling size estimated, to detect what difference?)  

6. What is a last stage sampling (a two-stage cluster sampling?)  

7. Some details could be summarized throughout the method: for example about the operational implementation of the quantitative and qualitative surveys, the software description, the list of variables is actually in the tables, it could be summarized by main categories with a questionnaire in SI  

8. The section about using the study findings is very interesting but is more related to the discussion, and use of the study findings  

9. Why did the authors decide not to analyze the data for both states together: it would be interesting to have results within each state and for the two states together  

10. A couple of relevant covariates potentially explaining measles vaccination coverage seem to be missing: such as religion, ethnicity (linked to different cultural background), knowledge of measles, access to care (such as where children go in case of fever). The author should specify whether this information was collected/analyzed, and if not why it was not done, and explain it as a limitation.  

11. Regarding the outcome “injection into the upper arm at 9 months”. It seems that this question could be confused with other vaccination which are not measles?  

12. Why did the authors not check the vaccination card? It could have helped quantify the uncertainty around the estimation.  

Result  

13. Why are there more mothers (and households) than children? The study population being children aged 12-23 months, the number of mothers for which data were used should be the same or smaller  

14. The quantitative results appear a bit like a repetition of the table. I would suggest to extract the main relevant information form the tables, and provide for the main significant factors OR and 95% CI insisting on what are the common factors between the two states and the main differences (rather than going first with univariate, then bivariate, then multivariate for one state, then multivariate for the other one)  

15. Regarding the results of the focus group discussion the number of quotations could be reduced to a maximum of 2-3 per topic  

16. The entire paragraph on “use of findings in planning should be in the discussion ” is very relevant and interesting but makes more sense in the discussion when mentioning the implications for policy makers
Discussion

17. I would suggest the authors should reformulate the discussion according to following guidelines - “The case for structuring the discussion of scientific”, BMJ, 1999 with the following categories:

a. Statement of principal findings
b. Strengths and weaknesses of the study
c. Strengths and weaknesses in relation to other studies, discussing particularly any differences in results
d. Meaning of the study: possible mechanisms and implications for clinicians or policymakers
e. Unanswered questions and future research

18. In the first paragraph what is the official national average?
19. In the first paragraph - How do the observed results compare with WHO guidelines for measles vaccination coverage?
20. What was the perception of measles in those communities? Did they consider the disease as an important one? The decision of vaccination also rely on the perception of vaccination safety/efficacy versus perceived risk of disease

21. The 5th paragraph around CASCADA is a bit confusing. It seems to be disconnected from the rest of the discussion, and the formulation itself is a bit confusing. I believe the point here is explained later in the discussion - educational campaign helps improve vaccination rate. I would remove this paragraph.
22. Regarding the discussion round birth certificate. Mothers with birth certificates are more likely to vaccinate their child maybe because it is actually believed that vaccination is free only with a birth certificate (mothers with birth certificates may also pay more attention to healthcare?). So I am a bit confused about why the author states that “possession of a birth certificate ……, so this is unlikely to explain the association”. It seems to me that it is actually likely as a proxy.
23. The 7th and 8th paragraphs are results, and should be in the results section.
24. Among the limitation besides recall bias and the fact we can’t establish any causality, there are potential limitations around the missing collected variables as explained above

Conclusion

25. Is 80% considered low? Even though below WHO threshold it is quite high (or at least medium coverage)?

26. I thought vaccination was already provided free of charge? The recommendation should be more around informing that vaccination is free regardless of whether you have a birth certificate.
**Level of interest:** An article whose findings are important to those with closely related research interests

**Quality of written English:** Needs some language corrections before being published

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

I declare that I have no competing interests