Author's response to reviews

Title: Inequitable Childhood Immunization Uptake in Nigeria: A Multilevel Analysis of Individual and Contextual Determinants.

Authors:

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Author's response to reviews: see over
Response to reviewers` comments

Reviewer 1 (Julie Bettinger):

Major compulsory revisions:

1. Author should indicate how the preference groups were selected in each category and the justification for this.

Author response:

As much as possible, the reference groups of the assessed variables had the least risks among the categories. Their selections were generally based on findings from published literature. For example, in the variable “mothers’ education”, “secondary or higher” education was the reference group, based on the known fact that children of mothers with higher education have higher likelihood of immunization, lower risks of death etc.

2. Author should indicate how missing data were handled, which categories had missing data and the amount of data that were missing.

Author response:

Missing data were excluded from the analysis (See page X). Amount of data was negligible.

3. How was each low, middle, high category for the different variables defined? How were they chosen? For example what does a mother’s education that is low mean? What does high education signify?

Author response:

The low, middle, high community-level categories were defined using the cut-off at median value in all PSUs combined. “Middle” referring to the proportion at the median value, “low” referring to the proportion below the median value, and “high” referring to the proportion above the median value. Community prenatal care by doctor was assessed because prenatal care directly increases the chances that mothers would access subsequent health care services for their child, such as institutional delivery and immunization. Community hospital delivery was included because the proportion of mothers that delivered in a hospital setting is a predictor of child immunization uptake. Hospital delivery is one of the most important preventive measures against maternal and child health outcomes, and an important determinant of full immunization. Community mother’s education was assessed because higher levels of maternal education are associated with better child health outcomes, such as child immunization rates. (See page X).

4. Author needs to describe the limitations of the work.

Author response:

Limitations of the study have been included (See page X under discussion section).
5. The author is not presenting new information; therefore the relevance of the findings need to be more fully discussed.

**Author response:**
Done. See extended conclusion.

6. The author mentions looking at the association between migration and the risk of under-five deaths, but does not provide any background as to why this is relevant. Nor is it explored in the tables. It is only briefly touched upon in the discussion. The relevance of the death/migration link needs to be further explained.

**Author response:**
Not applicable.

7. The author needs to more fully develop the link between immunization and prevention of childhood mortality in the background and discussion. What percentage of childhood deaths could be prevented with full or partial immunization?

**Author response:**
Vaccines are among the most effective preventive health measures in reducing child mortality, morbidity, and disability [13] [14]. The introduction of appropriate vaccines for routine use on infants has resulted in drastic reductions in vaccine-preventable diseases [3] [15]. The Expanded Program on immunization (EPI) in middle- and low-income countries has prevented more than 2 million child deaths from the tuberculosis, diphtheria, tetanus, pertussis, polio, and measles each year since its initiation in 1974 [16]. In addition, with the establishment of the Global Polio Eradication Initiative in 1988, immunization has resulted in a 99 percent reduction in the worldwide incidence of poliomyelitis [16] [17]. By reducing morbidity and mortality, Immunization is expected to contribute significantly to the achievement of the Millennium Development Goal – 4 (to achieve a two-thirds reduction in mortality rates for children under the age of 5 years between 1990 and 2015 [18].

(See 2nd paragraph under “Introduction” on page 3).

**Minor revisions:**
1. Immunization is not a risk. The author needs to reword phrases such as “risks of immunization” and “increase the risk of a child being fully immunized…” to something such as greater likelihood of immunization….

**Author response:**
Done. “Risks of immunization” have been replaced with “likelihood of immunization” wherever necessary.

2. What does the “Other” ethnicity group consist of?

**Author response:**
The “Other” ethnic groups refer to a merger of various other minority ethnic groups from the more than 374 identifiable ethnic groups in Nigeria (See under “Individual-level risk factors” in page 5).

3. Model 2 and Model 3 results should be clarified in Table 2.

**Author response:**

4. Last paragraph page 7 “..vary in order to investigate whether their effects are different across contexts”. Define contexts.

**Author response:**
The three-level multilevel logistic regression model used in this study accounts for the hierarchical structure of the DHS data with children (level 1) nested within mothers (level 2) who were in turn nested within communities (level 3). In the statement above, we investigated whether the effects of child-level covariates were different across individual- (child and mother) and community-level contexts i.e. among individual and community populations in which the surveys were carried out.

5. Page 8, add reference group to the sentence “… immunization compared with the reference group (children of birth order…)

**Author response:**

6. Middle of page 8. Typo in “(OR = 0.62, 95% ..” should be 0.62.

**Author response:**
Not applicable! This may have occurred during pdf conversion in the reviewers copy.

7. Page 9. Add which table model 3 results are in.

**Author response:**
All results of the models are within Table 3 indicated at the beginning of the presentation of the multilevel results “Multilevel logistic regression analysis (Table 3)”

8. Discussion 1st paragraph “socio-economic characteristics are important in explaining the differences” (not differentials.

**Author response:**
OK. Correction made.
9. The description of Igbos as enterprising seems very subjective. Entrepreneurial may be a better word choice. Also “enterprising potentials” is not correct. Delete this from the sentence.

**Author response:**
Done. The sentence now reads “The Igbos (or Ibos) are a well educated people with high economic power. These characteristics increase their propensity to migrate from areas with poor economic opportunities into areas with higher economic opportunities…..

10. Page 10, 2nd paragraph 1st sentence should be economic potential, not economic potentials.

**Author response:**
Correction made.

11. Page 10, last paragraph. Use another non-statistical term to explain “demand factors”.

**Author response:**
Done. This sentence now reads “Though maternal education was not significantly associated with the risks of full immunization, household wealth and mothers’ occupation are factors that influence vaccination uptake, given that they influence parents’ likelihood to seek immunization protection for their child.

12. 1st sentence in conclusions: delete general. It should read “…the need to close individual and community level disparities,…!

**Author response:**
Done.

**Discretional revisions:**

1. Put the immunization schedule information in the introduction into a table rather than text.

**Author response:**
Done. Immunization schedule put in Table 1.

2. There are too many abbreviations. PSU (page 5) should be written out. Author should review other abbreviations and determine which are really necessary.

**Author response:**
Done. This has been reviewed.
Response to reviewers’ comments

Reviewer 2 (Belinda Loring):

Major compulsory revisions:
1. In the conclusion, maternal education is singled out as an urgently indicated intervention, yet this study found no statistically significant association between maternal education status and immunization. Whilst this statement may be supported by other research, it is not a conclusion that can be drawn from this study

Author response:
Education is intricately linked to occupation. Children of mothers with lower status occupations (Clerical, sales, services, and skilled manual) had a lower likelihood of receiving full immunization. Interventions to increase maternal education, improving maternal knowledge, attitudes, and uptake of vaccinations, as well as well as increasing the proportion of mothers receiving prenatal care, hospital delivery are in the right direction. (See conclusion).

Minor essential revisions:
1. Consistent capitalization (of Measles or measles)

Author response:
Done

2. Word “militating” (last paragraph of introduction) = “mitigating”

Author response:
Done.

3. Abbreviation of PSU not defined when first introduced in the article.

Author response:
Done

4. Number of minor English language and typographical errors throughout article which require revision.

Author response:
Done

Discretionary revisions:
1. Use of the word determinant (in stating that having a hospital delivery was a determinant of full immunization status) – consider “associated with” rather than determinant in this context.

Author response:
Done (See 2nd paragraph under “Discussion” on page 11).

2. Consider rephrasing the description of certain ethnic groups as “enterprising” as this is value-laden.

Author response:
Done. (See “The Igbos (or Ibos) are a well educated people with high economic power” in 1st paragraph under Discussion).

3. The author mentions that ethnic disparities may be explained by socio-economic differences – it would be helpful if their model could then test this by assessing the effect of ethnicity on immunization status controlling for socio-economic position.

Author response:
I beg to differ. The author is attempting to explain the findings of this study. If the author is to test every finding of this study within the model, the focus of the study would be derailed, and the main purpose of the study would be defeated. This recommendation is grounds for further studies. This has been included under conclusion of the study (See page 12).

4. The Limitations of the study are not clearly stated

Author response:
Limitations of the study have been included (See page 12 at the end of discussion section).

5. The author suggests a number of social and situational factors in the discussion which may explain the disparities, and I would consider addressing these social determinants of immunization status at least as important as increasing the % of hospital deliveries etc. I would have thought that the percentage of hospital deliveries is at least partly a proxy measure of access to health services in general, and that communities with less hospital deliveries also have lower immunization status because they have less access to health care in general (for socio-economic and geopolitical determinants the authors refer to in their discussion). This could be strengthened in the article.

Author response:
Done. A modification of the suggested explanation has been added (See 2nd paragraph page 11)

6. In Table 1, consider tallying the percentages according to the variable of the left hand side (rather than the other way round)

Author response:
Done.