

# The nexus between geographical distance and institutional delivery trends in Ethiopia: Evidence from nationwide surveys

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## 1 Abstract

2 **Background.** Appropriate and well-timed delivery care, including emergency obstetrics care,  
3 is key for maternal and newborn health and survival. Even though Ethiopia has implemented  
4 several strategies to enhance institutional delivery and decrease maternal mortality, rates of  
5 institutional delivery are low. This study aims to examine the role of distance to healthcare  
6 institutions on institutional delivery in Ethiopia, and how these have changed over time.

7 **Method.** This study used data from two rounds of the Ethiopian Demographic and Health  
8 Survey (2011 and 2016) as well as spatial database on the location of all healthcare facilities.  
9 The sample included 22,881 **women who delivered in the past ten years**, living in 1,295  
10 villages. Multivariable logistic regression analyses were utilized to investigate how the  
11 distance to health facilities and other potential determinants influence **facility delivery trends**.

12 **Results.** The rate of institutional delivery in Ethiopia has increased from 10% in 2011 to 26%  
13 in 2016. **Likewise, the average distance to national health facilities has decreased from 4.9**  
14 **km in 2011 to 4.7 km in 2016.** Nevertheless, women who live farther away from health  
15 facilities consistently exhibit a reduced probability of giving birth at those facilities. In  
16 addition, mothers that are more educated, work outside of agriculture, have completed more  
17 antenatal care visits as well as those that live in wealthier households in more urban areas,  
18 and cohabit with more educated husbands are more likely to **deliver in facilities**. These  
19 variables show consistent relevance in both survey rounds, suggesting that the key  
20 determinants remained largely unchanged throughout the study period.

**Commented [MP1]:** The line 9 is contradicting with line 102 and 103 i.e., here it is mentioned “delivered in past ten years while in line 102 and 103 it is “preceding five years”.

**Commented [MP2]:** In line 11, please use consistent words i.e., it would be better to write “institutional delivery” on the place of “facility delivery trends” as it is the main dependent variable and has appeared in the title also.

**Commented [MP3]:** The line 13-14 could be restructured as, “Likewise, at the national level, the average distance to health facilities has decreased from 4.9 km to 4.7 km from 2011 to 2016.

**Commented [MP4]:** In line 18, authors could write “deliver in health facilities” instead of “deliver in facilities”.

**Conclusion.** The consistent impact of distance to health facilities on institutional delivery in Ethiopia persists over time. This highlights the crucial role of physical accessibility in reducing maternal mortality rates, as enhancing access to healthcare facilities can greatly improve utilization of the service and ultimately improve the health and well-being of mothers and infants nationwide.

**Key words.** Accessibility of Health Services, Facility delivery, Institutional delivery, Facility distance, Distance to health facilities, Maternal health

## Introduction

Every day in 2017, there were more than 810 reported maternal deaths worldwide due to pregnancy and childbirth-related complications (World Health Organization, 2019a). An overwhelming (94%) of these tragic cases occurred in low- and middle-income countries (LMIC), with a significant contribution from Sub-Saharan Africa (SSA) (World Health Organization, 2014, 2019a, 2019b). In addition, pregnancy and childbirth complications have the potential to cause severe and long-lasting health problems for the affected women and their children, exacerbating the already challenging healthcare situation in the regions facing the highest burden (World Health Organization, 2014).

Ensuring access to high-quality maternal healthcare services, including institutional delivery, cannot be overstated, as it plays a vital role in safeguarding the well-being of both mothers and children and reducing the risk of complications. Nevertheless, various challenges and barriers impede the achievement of this essential goal, particularly in SSA, where less than 60% of births are attended by skilled personnel, in contrast to 96% in high-income countries (Sambo & World Health Organization. Regional Office for, 2014). Among the East African countries, Ethiopia had the lowest institutional delivery rate, with a value of 26.2 %, in stark contrast to the highest rate of 97% in Mozambique and a pooled rate of 87.47% for the entire region (Central Statistical Agency - CSA/Ethiopia & ICF, 2017; Doctor, Nkhana-Salimu, & Abdulsalam-Anibilowo, 2018; Tesema & Tessema, 2021; Uganda Bureau of Statistics, 2017; Were et al., 2017).

Maternal institutional delivery is influenced by a complex interplay of various factors, which can be categorized into demand and supply-side factors. Among the supply-side factors, the distance to healthcare institutions is one of the strong predictors and significantly impacts the physical accessibility of the service (Kumar, Dansereau, & Murray, 2014; McGuire, Kreif, &

**Commented [MP5]:** In line 22: Physical accessibility seems vague which could be replaced with “easily accessible health facility”.

**Commented [MP6]:** In line 40: From the words, “this essential goal” it is not clear what goal authors want to point out at.

**Commented [MP7]:** The intext citation in line 42 is also incorrect. The intext citations can be, (Sambo & World Health Organization, 2014) OR (Sambo & WHO, 2014).

**Commented [MP8]:** In line 48: Instead of “maternal institutional delivery” authors can simply write “institutional delivery” adding “maternal” word makes it confusing.

Smith, 2021; Nesbitt et al., 2016; Winfred et al., 2020). Nonetheless, the proximity to the health institution is influenced by various factors, including transportation infrastructure, geographical setup, and the economic conditions of the mothers (Dahab & Sakellariou, 2020). As a result, the interplay of these underlying mechanisms is complex, significantly affecting the accessibility of the service and ultimately influencing the likelihood of institutional delivery (Dotse-Gborgbortsi et al., 2022; Karra, Fink, & Canning, 2017; McGuire, Kreif, & Smith, 2021). Moreover, the strong connection between the accessibility of health institutions and the probability of institutional delivery is closely tied to the differentiation between urban and rural residence settings. Consequently, this association directly impacts equity considerations in healthcare access and services (Dotse-Gborgbortsi et al., 2022; Gao & Kelley, 2019; Winfred et al., 2020).

**Commented [MP9]:** In line 61, the meaning of “equity considerations” is not clear. Author could elaborate it more for clarity. Author could also mention among which groups there is inequitable access to healthcare services.

Ethiopia has taken a range of steps to enhance institutional delivery and subsequently maternal health, including the expansion of healthcare infrastructure (DeMaria, Smith, & Berhane, 2022; Ethiopia Ministry of Health, 2010, 2015). This has led to a potential reduction in the proximity to health facilities over time, along with the implementation of various interventions and policies aimed at bolstering institutional delivery (Berelie et al., 2020; Zewdu Amdie, Landers, & Woo, 2022). Notably, the Ethiopian Demographic and Health Survey (EDHS) indicated a rise in institutional delivery rates from 10% in 2011 to 26% in 2016 (Central Statistical Agency - CSA/Ethiopia & ICF, 2017; Ethiopian Central Statistics Authority & ORC Macro, 2012). However, there is little documented evidence on the actual distance of households from their nearby health facility and how this impacts institutional delivery rates on a national scale. Thus, the current study aimed at investigating the role of distance on the trends of institutional delivery over time. This involved an integration of data from two rounds of Ethiopian demographic and health survey (EDHS) data and geographic positioning system (GPS) data of households with GPS data of health facilities from a recently established spatial database (Maina et al., 2019).

**Commented [MP10]:** In line 73-74, the research objectives could be refined more. This line could be rewritten as, “Thus, current study primarily focuses on two objectives viz., (1) to assess the trends of distance from health facility and institutional delivery among women aged 15-49 in Ethiopia between 2011 to 2016, and (2) to investigate the association between distance to health facility and institutional delivery among women aged 15-49 in Ethiopia.”

## Methods

### Study setting

Ethiopia is one of the world’s ancient states and the second most populous country in Africa, with a population of over 110 million. Ethiopia is a low-income countries with a GDP per capita of 936 USD and low levels of income inequality (The World Bank, 2021). Though

**Commented [MP11]:** In line 79, the sub-heading “study setting” could be rewritten as “Health care system in the study area”. Thereafter, authors could write first about Ethiopia and then the healthcare system of Ethiopia under this subheading.

**Commented [MP12]:** In line 81, “country” should be written NOT “countries” as Ethiopia.

maternal delivery care is provided by public, private and nongovernmental healthcare sectors, the vast majority is provided by public sectors. The public health sector has a three-tier system comprising Primary Health Care Units (PHCUs), General Hospitals and Specialized Hospitals. The PHCU includes primary hospitals, health centers and satellite Health Posts (Tiruneh, McLelland, & Plummer, 2020).

### **Study design**

Data analysis was conducted by integrating data from two repeated cross-sectional EDHS (2011 and 2016) and a spatial database of health facilities in sub-Saharan Africa (Central Statistical Agency - CSA/Ethiopia & ICF, 2017; Ethiopian Central Statistics Authority & ORC Macro, 2012; Maina et al., 2019). The sampling frame used for both the 2011 and 2016 EDHS is the Population and Housing Census conducted in Ethiopia in 2007 and provided by the Central Statistical Agency. All women aged 15-49 who were the usual members of the selected households and those who spent the night before the survey in the selected households were eligible to participate. The detailed sampling procedure for the survey has been reported elsewhere (Central Statistical Agency - CSA/Ethiopia & ICF, 2017). The spatial database of health facilities in Sub-Saharan Africa provides information on the exact geographic location of all public health facilities in the region for the year 2019. Therefore, it contains the list of all public health facilities in Ethiopia and their GPS coordinates.

### **Sample and data collection**

All women interviewed in the 2011 and 2016 EDHS, who delivered within the preceding five years were included in the study. As shown in Table 1, the analysis was based on weighted samples of 22,881 women living in 14,951 households located in 1,295 villages.

### **Table 1 is about here**

The spatial database lists 5,215 public health facilities of Ethiopia. Among these facilities 60% were primary health facilities (called clinics) and 40% were hospitals.

### **Statistical Analysis**

The geographic location of the village where mothers live (based on the EDHS) was linked to the nearest health facility (based on the spatial database). The distance between each survey cluster and the closest facility was calculated in kilometers. Bivariate and multivariate

**Commented [MP13]:** In line 88, "study design" subheading should be rewritten as "data source". Thereafter, the authors can explain about EDHS, its objectives, and study design in paragraph under this subhead. For formatting of method section of this article I recommend authors to see this paper, <https://peerj.com/articles/2675/> and modify their manuscript accordingly.

**Commented [MP14]:** In line 101: Sample selection will go in the "data-source" (which is written as study design in this manuscript) subhead itself. There is no need to make a different heading for that.

**Commented [MP15]:** Line 105, table 1 is not needed as it does not provide much information and the information provided by table 1 is already written in line 104 and 106.

**Commented [MP16]:** In lines 109-111, it is not clear how authors have calculated the distance to health facility. This needs more elaboration. How this variable was created should be mentioned in the "outcome variables" which is missing in this paper. Please read article for more clarity, <https://peerj.com/articles/2675/>.

**Commented [MP17]:** In line 111, a more elaboration is required as what was independent variable for bivariate logistic regression and which variables were controlled for multivariate logistic regression.

112 logistic regressions were conducted to identify the potential determinants of institutional  
113 delivery.

114 **Result**

115 **Descriptive statistics**

116 Sample characteristics are shown in *Table 2*. In both surveys the great majority of women  
117 lived in rural area. More than half (57.1%) of women interviewed 2011 did not use ANC  
118 care, compared to 37.1% in 2016. In both survey rounds, less than 70% of women had no  
119 education, and roughly 2% had attained higher education. In both 2011 and 2016, less than  
120 5% of women were covered by health insurance.

121 **[Table 2 is about here]**

122 **Distance to health facilities**

123 The mean distance (in kilometers) of household to their closest public health facility varies  
124 across the regions of Ethiopia, as displayed in *Figure 1*. The national average distance was  
125 4.9 km (95% CI, 4.9, 4.9) in 2011 and 4.7 km (95%CI, 4.2, 5.1) in 2016. Except for two  
126 regions (Southern Nations, Nationalities and Peoples Region and Harari), the mean distance  
127 between villages and facilities decreased between 2011 and 2016 (see *figure 1*).

128 **[Figure 1 is about here]**

129 **Institutional delivery**

130 *Figure 2* shows the change in the rate of institutional delivery across survey rounds. In 2011  
131 90% of births occurred at home, compared to 73.8% in 2016.

132 **[Figure 2 is about here]**

133 *Figure 3* shows how the rate of institutional delivery over time for the most recent births  
134 between 2006 and 2016. As shown below, the proportion of births occurring in health  
135 facilities increased over the study period from 13.8% in 2006 to 22.7% in 2012 to 39.5% in  
136 2016.

137 **[Figure 3 is about here]**

138 **Determinants of institutional delivery in 2011**

**Commented [MP18]:** In line 115, this subheading could be renamed as “Socio-demographic and health profile of study participants”.

**Commented [MP19]:** Line 122, the subheading could be renamed as “Trend of distance to health facility in Ethiopia (2011-2016)”. Then the contents under this heading should explain how distance to health facilities has changed between EDHS-3 and EDHS-4.

**Commented [MP20]:** In line 129, the subheading could be renamed as “Trend of institutional delivery in Ethiopia (2006-2016)”.

**Commented [MP21]:** In line 138, the subheading, “Determinants of institutional delivery in 2011” and next subheading namely “Determinants of institutional delivery in 2016” should be merged into one with name, “Change in the determinants of institutional delivery in Ethiopia (2011-2016)”.

139 Table 3 shows factors associated with institutional delivery in Ethiopia in 2011. All models  
140 were estimated using logistic regression. Model 1 includes only the distance between the  
141 village where the woman lives and the distance to the nearest health facility (in km). Model 2  
142 includes only women's individual characteristics and Model 3 includes only household  
143 characteristics. Model 4 includes all the above-mentioned variables.

144 Distance to health facilities explained 7.1% (Nagelkerke R-squared) of the variation in  
145 institutional delivery (see Model 1). Individual characteristics explained 41.6% (Nagelkerke  
146 R-squared) and household characteristics explained 41.4% (Nagelkerke R-squared) of  
147 institutional delivery (see Model 2 and 3). All these factors combined explain 52.4%  
148 (Nagelkerke R-squared) of the variation in institutional delivery (see Model 4).

149 As shown in Model 1, women who have a health facility nearby are more likely to deliver in  
150 a facility. A one-kilometer increase in the distance to the nearest health facility reduces the  
151 likelihood of delivering at health facility with an odds ratio of 0.79. Distance to health  
152 facilities remains an important driver, also when individual and household characteristics are  
153 controlled for. On the other hand, women who had more ANC visits are more likely to  
154 deliver at health facilities, as shown in Model 2. For instance, mothers who had four or more  
155 ANC visits were 9 times more likely to deliver at facilities than those who had no ANC visits.  
156 Women aged less than 20 were less likely to deliver in facility compared with women aged  
157 35-49 (odds ratio of 0.38).

158 In Model 3, wealth, urban, residence, and husband/partner education level were significantly  
159 associated with institutional delivery. For instance, for women in the poorest group the odds  
160 of delivering at facilities were 0.15 times lower than the richest group. Women who were  
161 living in urban areas were 4 times more likely to deliver at health facility.

162 As shown in Model 4, findings remain similar when all factors are included alongside one  
163 another.

164 [Table 3 is about here]

**Commented [MP22]:** In line 140-143, I suggest It would be better to run only one model (model 4<sup>th</sup>) which is adjusted for individual and household level characteristics. Run only model 4<sup>th</sup> for EDHS-3 and EDHS-4 separately then make a single table for Odds ratios of 2011 and 2016. Two tables are not required.

**Commented [MP23]:** In paragraph (line 144-148), the pseudo-r squared or Nagelkerke R-Squared is explained but it is not given in regression table (table 3 and 4). So, I suggest to add a row in the table showing Nagerlkerke R-Squared values as well.

**Commented [MP24]:** Line 151 and entire result section: The reporting of Odd Ratio (OR) values and their explanation needs further refinement, not only here but in entire result section. Please refer to this article to know how to report OR values and how to explain them in your paper.  
<https://peerj.com/articles/592/>

***Determinants of institutional delivery in 2016***

*Table 4* shows factors associated with institutional delivery in Ethiopia in 2016. Model 1 includes only the distance between the village where the woman lives and the distance to the nearest health facility (in km). Model 2 includes only women's individual characteristics and Model 3 includes only household characteristics. Model 4 includes all variables. Distance to health facilities explains 6.1 % (Nagelkerke R-squared) of the variation in facility delivery. Individual characteristics explain 40.6% (Nagelkerke R-squared) and household characteristics explain 30.7% (Nagelkerke R-squared). All these factors combined explain 47.9% (Nagelkerke R-squared) of the variation in facility delivery.

As shown in Model 1, a kilometer increase in the distance between a woman's village and her nearest health facility reduces the likelihood of delivering at health facility (odds ratio of 0.84). Women who had more ANC visits, are older, employed, wealthier or have more educated partners are more likely to deliver in health facilities. As was the case in 2011, results on potential determinants hold when all factors considered in the analysis are included alongside one another.

Overall, results on potential determinants are similar in 2016 and 2011 except husband's education, sex of household head, religion, and health insurance status. Women with partners that have secondary schooling or above are more likely to deliver in a facility in 2016 than 2011. On the other hand, the tendency of delivering at health facilities for women living in male-headed household were less likely in 2016 than 2011. Insurance coverage appeared to positively influence institutional delivery in 2016. Similarly, Muslim mothers were more likely to deliver in health facilities in 2016 than 2011.

**[Table 4 is about here]**

## Discussion

In this study we examined the role of health facility distance on institutional delivery in Ethiopia. Despite the increase in rate of institutional deliveries from 10% to 26.2% and a decrease of 0.2 km in the average distance to health facilities between 2011 and 2016, the likelihood of women giving birth at healthcare facilities remained relatively low. Regression analysis also indicated that mothers that were older, more educated, work outside of agriculture, have completed more antenatal care visits as well as those that lived in wealthier households in more urban areas, and cohabited with more educated husbands were more likely to deliver in facilities. These factors are relevant in both rounds of survey data – suggesting that potential determinants have not changed over the study period, although the rate of institutional delivery increased.

This study found that distance from the health facility is an important factor in determining institutional delivery. Women living near to the facility had a higher chance of giving birth at a health facility than women living farther away. In line with this, regions characterized by greater average distances to health facilities (such as Somalia and Afar) demonstrated persistently low rates of institutional delivery, as indicated by the latest spatial data analysis of EDHS (Awol, Edosa, & Jemal, 2023). This finding is in line with studies from other settings (Gage & Calixte, 2006; Karra, Fink, & Canning, 2017; Kumar, Dansereau, & Murray, 2014; McGuire, Kreif, & Smith, 2021). Distance likely plays a role because it determines the cost of accessing care via transportation costs, as well as ease of access. In addition, women who lived nearer to facilities might be more likely to complete ANC visits – which could result in a virtuous cycle (Dotse-Gborgbortsi et al., 2022).

Findings on other potential determinants are also in line with other studies. Older mothers were more likely to deliver in facilities, which is in line with previous findings (Gabrysch & Campbell, 2009; Gedilu, Debalkie, & Setegn, 2018). The same is true for women's employment status (Mitikie, Wassie, & Beyene, 2020), which was positively associated with institutional delivery, potentially because women have more financial resources or higher bargaining power within the household. In line with evidence from 74 LMICs (Hasan et al., 2021) and previous work in Ethiopia (Fikre & Demissie, 2012; Gabrysch & Campbell, 2009; Gedilu, Debalkie, & Setegn, 2018), we also found that more educated women were more likely to deliver in facilities (Tesema & Tessema, 2021). This can be explained by multiple

**Commented [MP25]:** In line 206-207, sentence needs to be rewritten with a refinement.



219 prospective pathways, for instance, more educated women likely have more access to  
220 financial resource, higher health knowledge or increased awareness about the potential  
221 benefits of institutional delivery. In addition, more educated women are more likely to  
222 cohabit with more educated partners, meaning that social norms or household decision  
223 making structures could differ and be more beneficial to women. In line with previous works  
224 (Gedilu, Debalkie, & Setegn, 2018; Mitikie, Wassie, & Beyene, 2020; Yoseph et al., 2020),  
225 we found that women who complete more ANC visits are more likely to deliver in facilities.  
226 This might be because institutional delivery and ANC visits have similar determinants, or  
227 because ANC visits link women with healthcare providers and foster trusting relationships.

228 In terms of household characteristics, our study, as well as previous literatures (Gabrysch &  
229 Campbell, 2009; Hasan et al., 2021; Yoseph et al., 2020) finds that women living in  
230 wealthier households were more likely to deliver in facilities. The possible explanation could  
231 be that wealth is correlated with education, or that women from wealthier backgrounds find it  
232 easier to cover the costs of healthcare and travel. Husband's education and husband's work  
233 status were also another **significantly factors** which associated positively with institutional  
234 delivery, as is found in other studies (Mitikie, Wassie, & Beyene, 2020; Yoseph et al., 2020).  
235 A possible reason for this is educated husbands are more likely to have occupations which  
236 can cover the health cost and different related fees. At the same time, they may be more  
237 receptive toward modern medicine, informed of the advantages of health facility delivery and  
238 more able to communicate with health professionals.

239 **This study has limitations in three main respects.** First, by calculating distances to the nearest  
240 facility, we implicitly assume that women would want to go to their closest health facility.  
241 This could introduce bias if women perceive quality to be poor in these facilities, or if levels  
242 of absenteeism are high and facilities are de-facto closed. Second, we did not examine  
243 cultural factors although these are identified as important in previous work. Finally, we did  
244 not investigate the quality of care in health facilities – which was not possible due to lack of  
245 data.

246 The findings of this study are nonetheless relevant for policymakers for several reasons as it  
247 is the first nationally representative evidence on the role of distance from Ethiopia, and the  
248 first study to use data on the **actual location** of households and facilities. Although we  
249 identify other determinants of institutional delivery, this likely highlight that there is a need to  
250 increase the number of health facilities, particularly in rural regions. In addition, given that

**Commented [MP26]:** In line 233, the “significant factors” is more correct than “significantly factors”.

**Commented [MP27]:** Line 239, could be written as, “This study has three main limitations” instead of writing “This study has limitations in three main respects”.

**Commented [MP28]:** Line 248, as per my knowledge DHS divert the real location of household to few kilometers to ensure the privacy of study participants. Then why authors are mentioning that this use data on actual location of households.

251 travelling long distances can be cumbersome for women when infrastructure is poor, there is  
252 likely a need to improve infrastructural quality – particularly in rural areas (Dotse-  
253 Gborgbortsi et al., 2022). Whilst building more healthcare facilities is achievable in the short  
254 term, staffing is likely a key limitation. Ethiopia suffers from a severe shortage of healthcare  
255 staff, as there are only 0.96 healthcare workers per 1,000 population – which is far below the  
256 WHO target (Haileamlak, 2018). Hence, an increase in the number of health facilities likely  
257 has to go hand-in-hand with increased recruitment and training of providers. Second, we  
258 highlight the importance of factors that are likely to take a longer time to change. Whether or  
259 not women deliver at health facilities is associated with their broader socio-economic status  
260 (education and wealth), and that of their husbands. This underlines that low levels of facility  
261 delivery in Ethiopia likely have deep rooted causes. Hence, the goal to improve institutional  
262 delivery likely has to go hand-in-hand with other improvements in people’s lives, which are  
263 likely only achievable in the long term.

264 In terms of future research, we have three main recommendations. First, there is a need for  
265 more work on the determinants of healthcare facility delivery, to identify potentially relevant  
266 factors. Second, there is a need to test different interventions that could be implemented to  
267 improve institutional delivery. Finally, there is a need to investigate whether institutional  
268 delivery improves health outcomes. Given the poor quality of healthcare delivered in many  
269 LMICs, high-quality evidence is needed on whether improving institutional delivery has real  
270 consequences for maternal mortality in LMICs.

271 **Conclusion**

272 The rate of institutional delivery increased from 10% to 26.2% in parallel with average  
273 national health facility distance reduction from 4.9 km to 4.7 km in 2011 and 2016,  
274 respectively. However, rates of institutional delivery are still low compared to most of sub-  
275 Saharan African and the potential influencing factors remain comparable in both 2016 and  
276 2011, with a particular emphasis on the sustained importance of physical accessibility. We  
277 recommend policy makers and researchers to consider these determinants during policy  
278 development.

**Acronyms**

ANC - Antenatal Care

**Commented [MP29]:** In line 256, it would be better if authors mention how many health workers per 1000 population is WHO’s target.

**Commented [MP30]:** In line 272-274, this needs to be rewritten so that it could be more meaningful. i.e., “The rate of institutional delivery increased from 10% in 2011 to 26.2% in 2016, accompanied by a reduction in the average distance to health facilities from 4.9km to 4.7km at the national level during the same period.”

DHS - Demographic and Health Surveys

EDHS - Ethiopian Demographic and Health Survey

GDP - Gross domestic product

GIS - Geographic information system

GPS - Global Positioning System

**LMICS** - Low and Middle-Income Countries

PHCUs - Primary Health Care Units

SSA - Sub-Saharan Africa

USD - United States dollar

WHO - World Health Organization

**Commented [MP31]:** It should be LMICs not LMICS

## **Acknowledgments**

We acknowledge the DHS program for permitting us to use the dataset.

## **Authors' contributions**

YBS and RK were involved in the conception, design, analysis, interpretation, report writing and manuscript writing. TT was involved in data analysis, interpretation, and manuscript writing. All authors have read and approved the final manuscript.

## **Funding**

This work has not received funding.

## **Declarations**

### **Ethics approval and consent to participate**

For this study, data were directly downloaded from the Measure DHS website, after obtaining approval for use of the data. DHS assures ethical aspects to protect each participant's privacy and rights during the data collection.

### **Consent for publication**

Not applicable.

### **Availability of data and material**

The datasets used and/or analysed during the current study are available at DHS website and from the listed refence.

**Competing interests**

The authors declare that they have no competing interests.

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