Geographical Access to Health Facilities and Maternal Healthcare Utilization in Benin: A Cross-sectional Study

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Abstract

Background: The world is making progress toward achieving maternal and child health (MCH) related components of the Sustainable Development Goals. Nevertheless, the progress of many countries in Sub-Saharan Africa is lagging. Geographical accessibility from residence to health facilities is suspected to be a major obstacle hampering the use of appropriate MCH services. Benin, a country with unique geographical characteristics whereby the southern and northern parts belong to different climatic zones, sees the highest maternal mortality rate among the world. Adequate use of MCH care is important to save lives of women and their babies. This study assessed the effect of distance to health facilities on maternal healthcare utilization in Benin, with an emphasis on geographical zones.

Methods: We pooled two rounds of Benin Demographic and Health Surveys (BDHS). The sample included 32,727 women aged 15–49 years (16,599 from BDHS-2011/2012 and 15,928 from BDHS-2017/2018). We measured the distance from residential areas to the closest health center by merging the BDHS datasets with Benin's geographic information system data. Multivariate logistic regression analysis was performed to estimate the effect of distance on maternal healthcare utilization. We conducted a propensity score-matching analysis to check for robustness.

Results: Regression results showed that the distance to the closest health center had adverse effects on the likelihood of a woman receiving appropriate maternal healthcare. The estimates showed that one km increase in distance to the nearest health center reduces the odds of the woman receiving at least one antenatal care by 0.034, delivering in facility by 0.020, and delivering her baby with assistance of skilled birth attendants by 0.028. Nonetheless, these effects were mainly seen in the northern part of Benin.

Conclusions: Geographical accessibility to health facilities is critically important for the improvement of appropriate maternal healthcare, particularly in the northern part of Benin. Investment in transport infrastructure should be prioritized for further improvements in the MCH.

Plain English Summary

Maternal and neonatal mortality rates are still high in many countries in Sub-Saharan Africa. Antenatal care (ANC) visits and institutional delivery with skilled birth attendants are important to prevent maternal and neonatal deaths. Nevertheless, women's utilization of maternal healthcare services has seen a decreasing trend in Benin, a country with unique geographical characteristics whereby the southern and northern parts belong to different climatic zones.

Geographical accessibility from residence to health facilities is suspected to be a major obstacle hampering the use of appropriate maternal healthcare. This study assessed the effect of distance on maternal healthcare utilization in Benin by considering the geographical characteristics.

We used the two rounds of the Benin Demographic and Health Survey 2011/2012 and 2017/2018 and conducted regression analysis. Our main predictor was distance from a residence to the nearest health center.

This study has three important findings: 1) We confirmed adverse effects of distance on the likelihood of a woman receiving appropriate maternal healthcare in Benin, but this effect was mainly observed in the northern part; 2) Distance to health facilities had a negative effect on the use of at least one ANC but no significant effect for four or more ANC; 3) Regarding the threshold of distance, we confirmed that women living within 5 km from the closest health center were more likely to use maternal healthcare compared to their counterparts.

In conclusion, geographical accessibility to health facilities is critically important for the improvement of maternal health, particularly in the northern part of Benin.

Background

Maternal and child health (MCH) care is an important investment a country can make to build human capital and boost economic growth (1). It should be emphasized that the world is making progress toward MCH improvement. The maternal mortality ratio fell from 342 deaths to 211 deaths per 100,000 live births between 2000 and 2017. The neonatal mortality rate fell from 31 deaths to 18 deaths per 1,000 deaths between 2000 and 2018. Nevertheless, maternal, neonatal, and child mortality rates are still high in many countries in Sub-Saharan Africa. For instance, in the Benin Republic, a coastal country located in West Africa, the maternal mortality ratio was 391 per 100,000 live births in 2018 (2).

Maternal deaths particularly occur during labor, delivery, and the immediate postpartum period, with obstetric hemorrhage being the leading cause (3, 4). Empirical studies have demonstrated that antenatal care (ANC) visits, institutional delivery with skilled birth attendants (SBA), and postnatal care are important to prevent maternal and neonatal deaths (4, 5). In Benin, women's utilization of maternal healthcare services has seen a decreasing trend. The percentage of women receiving at least one ANC shifted from 86% in 2011 to 83% in 2018, and those visiting at least four ANCs, as recommended by the World Health Organization (WHO), declined from 58–52% during the same period (2). Moreover, there are still a certain number of women who gave birth at alternative places such as their homes and those of traditional birth attendants who are not knowledgeable in modern obstetric care (6).

Among the determinants of not utilizing appropriate maternal healthcare services in Sub-Saharan Africa, geographical accessibility to health facilities is considered a major obstacle (7–11). Although several empirical studies on the issue of maternal healthcare service utilization in Benin have been conducted (6, 12, 13), they mainly focused on the individual, household, and community levels. No study has analyzed the effects of geographical access to health facilities on maternal healthcare utilization by considering the geographical characteristics of Benin. Therefore, we conducted our study to analyze geographical access to health facilities on maternal healthcare utilization in Benin. Our study suggests that improvement of geographical accessibility should be prioritized for MCH, particularly in the northern part of Benin.
Methods

Data

We used two latest cross-sectional data from the Benin Demographic and Health Survey (BDHS), 2017/2018 (2) and 2011/2012 (14). Regarding the sampling design, in the first stage of BDHS 2017/2018, 555 primary sampling units (clusters) were drawn from the list of 12,633 enumeration areas established during the fourth General Census of the Population and Housing in 2013 (2). In BDHS 2011/2012, 750 clusters were selected from the enumeration areas (14).

In the second stage, 26 households and 24 households per cluster were selected in BDHS 2017/2018 and BDHS 2011/2012, respectively. In BDHS 2017/2018, 14,156 households and 15,928 women were surveyed (2), while 17,422 households and 16,599 women were surveyed (14) in BDHS 2011/2012. We used data of 15,928 women from BDHS 2017/2018 and 16,599 women from BDHS 2011/2012 who had live births within five years preceding the surveys as a study sample.

Our main explanatory variable was the distance from the residential area to the closest health center. During data collection, information regarding the distance to the closest health facility and travel time was collected on BDHS 2017/2018, but the data had many missing values. Therefore, we used the geographical information system (GIS) module of the BDHS to calculate these distances.

Maina et al. (2019) assembled health facilities managed by the public sector of 50 Sub-Saharan African countries using a spatial dataset (15). The dataset is available on the WHO’s Global Malaria website (16). We extracted data Benin’s data from this dataset. Information on Benin's road infrastructure was obtained from the World Bank website (17).

To measure the distance from one’s residence to the closest health facility, we used the Euclidean distance (km), a straight-line distance from a residence to the closest health facility (18). The advantage of this method is that it can be generalized for other similar topography and cultural contexts in Sub-Saharan Africa (18). Additionally, we analyzed whether the availability of means of transport at the community level was associated with maternal healthcare utilization. The BDHS contains questions about whether the household owned a bicycle or motorbike. Because bicycles and motorbikes are popular means of transport in Benin, they can be used to travel when seeking maternal healthcare at health facilities (19). Thus, we calculated the ownership rates of bicycles and motorbikes per cluster and used them as proxy variables for community-level availability of means of transport.

Statistical analysis

We applied multivariate logistic regressions to analyze the impact of distance to the closest health center on maternal healthcare utilization. Data analysis was performed using Stata version 14. Because BDHS applied a two-stage cluster sampling design, we used the svy (survey) commands of Stata to correct for unequal sampling probability, clustering, and stratification to calculate descriptive statistics and perform regression analysis. Additionally, we conducted propensity score matching (PSM) analysis to check the robustness of the logistic regression. The PSM attempts to estimate the effects of a specific policy or treatment in observational studies by reducing the bias arising from confounding factors that might predict outcome variables. It matches treated and untreated units based on a set of basic characteristics and attempts to balance both groups. According to the National Health Development Plan (NHDP) 2009–2018 of Benin, geographical accessibility to healthcare services in Benin was defined as “the percentage of the population living within 5 km of the closest health center” (20). Therefore, we created two groups, the treatment group (women living more than 5 km from the closest health center) and a comparison group (women living within 5 km from the closest health facility) to assess whether the threshold (5 km from the closest health center) had adverse effects on women’s use of appropriate maternal healthcare.

Outcome variables

We used the following outcome variables: 1) whether the woman made at least one ANC visit during her latest pregnancy (“any ANC”); 2) whether the woman made four or more ANC visits during her latest pregnancy (“≥ 4 ANC”); 3) whether the woman used a health facility at the birth-delivery (“Facility delivery”); and 4) whether the woman was attended by a professional health worker (i.e., doctor, nurse, auxiliary nurse, or midwife at birth (delivery by SBA). Because all the outcome variables were binary, they were coded 1 if the mother had received appropriate healthcare (ANC, facility delivery, or SBA) during pregnancy or childbirth, and 0 otherwise.

Control variables

We used mother-, household-, and community-level characteristics as control variables. Mother-level variables comprised age and educational achievement (no education, primary, secondary/higher). Household-level variables included religion of the household head (Muslim, Protestant, Catholic, Vodoum/other traditional, and No religion/others) and asset quintiles. Community-level variables included geographical zones of a residence (south or north of the country), as well as the ownership rates of bicycles and motorbikes.

Results

Sample characteristics

Table 1 summarizes the characteristics of the study participants. After merging two rounds of BDHS, 18,105 births (50.3% from BDHS 2011/2012 and 48.7% from BDHS 2017/2018), were included in this study. Regarding geographical zones, 55.7% of the sample represented southern, while 44.3% represented the northern part of the country. Regarding outcome variables, 84.1% of the women received ANC at least once, and 55.7% received ANC four times or more. Of all the women, 85.7% delivered their babies at health facilities, and 81.4% were assisted by SBA at childbirth. These figures differed significantly between the geographical zones. Although 92.2% and 69.5% of the women received at least one ANC and four or more ANC in the South, only 73.1% and 38.6% of the...
women received the same care in the North. Regarding childbirth, 95.4% of the women delivered their babies at health facilities and 91.9% were assisted by SBA in the South, but only 73.6% and 68.3% of the women received the same care in the North. Regarding the main predictor, the mean distance from a residence to the closest health facility was 3.65 km in the full sample. The distance in the north (5.24 km) was twice as long as that in the South (2.35 km). Looking at as a distance dummy variable, 22.6% of the households lived more than 5 km away from the closest health center in the full sample. The percentage was almost three times higher in the North (37.0%) than in the South (11.2%).

Regarding mothers’ characteristics, their mean age was 29.3 years. Of all the mothers, 68.6% were not formally educated; only 14.4% had completed secondary education or higher. As for household characteristics, 29.1% of the household heads were Muslim, followed by Protestants (27.4%), Catholics (24.3%), Vodoum/other traditional religion (12%), and no religion/others (7.2%). Regarding community characteristics, the ownership rates of bicycles and motorbikes were 31.0% and 62.2%, respectively.
Table 1
Sample characteristics

| Variables                        | Total         | South       | North       | South       | North       | South       | North       |
|----------------------------------|---------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                                  | Obs | Mean | S.D. | Obs | Mean | S.D. | Obs | Mean | S.D. |
| **Outcome variables**            |     |      |     |     |      |     |     |      |     |
| Received any ANC                 | 13,480 | 0.841 | 0.366 | 7,447 | 0.922 | 0.269 | 6,033 | 0.742 | 0.438 |
| Received ≥ 4 ANC                 | 13,480 | 0.557 | 0.497 | 7,447 | 0.695 | 0.460 | 6,033 | 0.386 | 0.487 |
| Facility delivery                | 18,077 | 0.857 | 0.350 | 10,073 | 0.954 | 0.209 | 8,004 | 0.736 | 0.441 |
| Delivery by SBA                  | 18,105 | 0.814 | 0.389 | 10,087 | 0.919 | 0.273 | 8,018 | 0.683 | 0.465 |
| **Main predictor**               |     |      |     |     |      |     |     |      |     |
| Distance dummy: 5 km or more     | 18,105 | 0.226 | 0.418 | 10,087 | 0.112 | 0.315 | 8,004 | 0.370 | 0.483 |
| Distance to health facilities (km)| 17,768 | 3.653 | 4.415 | 9,750 | 2.350 | 2.184 | 8,018 | 5.237 | 5.729 |
| **Mothers’ characteristics**    |     |      |     |     |      |     |     |      |     |
| Age                              | 18,105 | 29.345 | 6.829 | 10,087 | 29.656 | 6.657 | 8,018 | 28.955 | 7.020 |
| Education                        |     |      |     |     |      |     |     |      |     |
| No education                     | 18,105 | 0.686 | 0.464 | 10,087 | 0.614 | 0.487 | 8,018 | 0.777 | 0.416 |
| Primary                          | 18,105 | 0.170 | 0.375 | 10,087 | 0.208 | 0.406 | 8,018 | 0.122 | 0.327 |
| Secondary/Higher                 | 18,105 | 0.144 | 0.351 | 10,087 | 0.178 | 0.383 | 8,018 | 0.102 | 0.302 |
| **Households’ characteristics** |     |      |     |     |      |     |     |      |     |
| Religion                         |     |      |     |     |      |     |     |      |     |
| Muslim                           | 18,105 | 0.291 | 0.454 | 10,087 | 0.080 | 0.271 | 8,018 | 0.557 | 0.497 |
| Protestant                       | 18,105 | 0.274 | 0.446 | 10,087 | 0.402 | 0.490 | 8,018 | 0.113 | 0.317 |
| Catholic                         | 18,105 | 0.243 | 0.429 | 10,087 | 0.290 | 0.454 | 8,018 | 0.184 | 0.388 |
| Vodoum/other traditional         | 18,105 | 0.120 | 0.324 | 10,087 | 0.170 | 0.376 | 8,018 | 0.056 | 0.230 |
| No religion/others               | 18,105 | 0.072 | 0.259 | 10,087 | 0.058 | 0.234 | 8,018 | 0.089 | 0.285 |
| Asset                            |     |      |     |     |      |     |     |      |     |
| Lowest                           | 18,105 | 0.216 | 0.412 | 10,087 | 0.139 | 0.346 | 8,018 | 0.313 | 0.464 |
| Lower middle                     | 18,105 | 0.207 | 0.405 | 10,087 | 0.177 | 0.381 | 8,018 | 0.246 | 0.431 |
| Middle                           | 18,105 | 0.205 | 0.404 | 10,087 | 0.195 | 0.397 | 8,018 | 0.217 | 0.412 |
| Upper middle                     | 18,105 | 0.197 | 0.397 | 10,087 | 0.231 | 0.422 | 8,018 | 0.153 | 0.360 |
| Highest                          | 18,105 | 0.175 | 0.380 | 10,087 | 0.258 | 0.437 | 8,018 | 0.071 | 0.257 |
| **Community’s characteristics**  |     |      |     |     |      |     |     |      |     |
| Ownership rate                   |     |      |     |     |      |     |     |      |     |
| Bicycle                          | 17,878 | 0.310 | 0.203 | 9,977 | 0.241 | 0.176 | 7,901 | 0.396 | 0.202 |
| Motorbike                        | 17,878 | 0.622 | 0.179 | 9,977 | 0.597 | 0.186 | 7,901 | 0.652 | 0.165 |
| Round                            |     |      |     |     |      |     |     |      |     |
| BDHS 2011/2012                   | 18,105 | 0.503 | 0.500 | 10,087 | 0.553 | 0.497 | 8,018 | 0.440 | 0.496 |
| BDHS 2017/2018                   | 18,105 | 0.497 | 0.500 | 10,087 | 0.447 | 0.497 | 8,018 | 0.560 | 0.496 |

Regression analysis

Table 2 presents the results of the multivariate logistic regression analysis for maternal healthcare utilization. The magnitude of the effects was assessed by odds ratio (OR), which can be interpreted as increasing (if OR > 1) or reducing (if OR < 1) the likelihood of using maternal healthcare. Regarding the main predictor (distance to the closest health center), there was a statistically significant and negative effect of having any ANC, facility delivery, and SBA, indicating that the longer the distance to the closest health center, the less likely women are to receive the necessary healthcare during pregnancy and childbirth. The estimated ORs for any ANC (OR = 0.966, p < 0.001) indicated that if the distance to the closest health center increased by one km, the odds of a woman receiving ANC at least once was reduced by 0.034. Similarly, the estimated ORs for facility delivery (OR = 0.980, p < 0.05) and SBA (OR = 0.972, p < 0.001) suggest that one-kilometer increase in distance decreases the odds of delivering a baby at a health facility by 0.02 and reduces the odds of being
assisted by SBA by 0.028. However, these results differed between geographical zones. In the South, a statistically significant and negative effect of distance on the use of maternal health care was confirmed only for SBA (OR = 0.940, \( p < 0.05 \)). On the other hand, distance had statistically negative effects on women's uptake of ANC (OR = 0.964, \( p < 0.001 \)), facility delivery (OR = 0.977, \( p < 0.05 \)), and SBA (OR = 0.969, \( p < 0.001 \)) in the North.
| Main predictor                  | Total | South | North |
|--------------------------------|-------|-------|-------|
|距医疗设施的路程              |       |       |       |
| Total                          | 0.966 (0.000)** | 1.002 (0.765) | 0.980 (0.024)* |
| ≥ 4 ANC                        | 0.972 (0.000)** | 0.978 (0.539) | 1.009 (0.619) |
| Facility                       | 0.961 (0.046)* | 0.940 (0.347) | 0.964 (0.000)** |
| SBA                            | 1.003 (0.000)** | 0.997 (0.013)* | 1.011 (0.012)* |
| Any ANC                        | 0.972 (0.000)** | 0.987 (0.726) | 0.993 (0.027) |
| ≥ 4 ANC                        | 1.005 (0.000)** | 0.993 (0.084) | 1.009 (0.304) |
| Facility                       | 1.011 (0.000)** | 1.003 (0.081) | 1.017 (0.145) |
| SBA                            | 0.972 (0.000)** | 0.987 (0.084) | 1.009 (0.304) |
| Age                            | 1.004 (0.028)* | 1.007 (0.013)* | 1.010 (0.012)* |
| Education                      |       |       |       |
| No education †                 |       |       |       |
| Primary                        | 2.127 (0.000)** | 1.494 (0.000)** | 2.025 (0.000)** |
| Secondary/Higher               | 1.645 (0.000)** | 1.760 (0.000)** | 3.259 (0.000)** |
| Household-level                |       |       |       |
| Religion                       |       |       |       |
| Muslim †                       |       |       |       |
| Protestant                     | 2.453 (0.000)** | 1.549 (0.000)** | 2.525 (0.000)** |
| Catholic                       | 2.601 (0.000)** | 1.425 (0.000)** | 2.955 (0.000)** |
| Vodoum/other traditional       | 1.504 (0.005)** | 1.075 (0.448) | 1.109 (0.479) |
| No religion/others             | 1.199 (0.209) | 1.042 (0.694) | 1.399 (0.016)* |
| Asset                          |       |       |       |
| Lowest †                       |       |       |       |
| Lower middle                  | 1.800 (0.000)** | 1.356 (0.000)** | 1.802 (0.000)** |
| Middle                        | 2.448 (0.000)** | 1.870 (0.000)** | 2.747 (0.000)** |
| Upper middle                  | 5.103 (0.000)** | 2.598 (0.000)** | 8.035 (0.000)** |
| Highest                       | 5.559 (0.000)** | 4.207 (0.000)** | 21.022 (0.000)** |
| Community-level                |       |       |       |
| Ownership rate                |       |       |       |
| Bicycle                       | 0.835 (0.488) | 0.863 (0.319) | 1.208 (0.467) |
| Motorbike                     | 1.520 (0.113) | 0.833 (0.259) | 1.480 (0.175) |
| Round                          |       |       |       |

*Significance levels: *p* < 0.10, **p** < 0.05, ***p*** < 0.01.
Table 3 presents the PSM results. In the full sample, the treatment dummy variable had a statistically significant and negative effect on receiving any ANC (OR = 0.961, p < 0.001) and facility delivery (OR = 0.975, p < 0.001), indicating that women who lived 5 km or more from the closest health center were less likely to use these services compared to the comparison group. Similar to the results from the logistic regression, the negative effects of distance on maternal healthcare utilization were confirmed in the northern part of the country. In south, there was no statistically significant effect of distance. In north, the distance had statistically and negative effects on women's uptake of ANC (OR = 0.967, p < 0.013), facility delivery (OR = 0.952, p < 0.001), and SBA (OR = 0.960, p < 0.001).

### Table 3

**Results of propensity score matching estimations**

|                          | Received any ANC | Received ≥ 4 ANC | Facility delivery | Delivery by SBA |
|--------------------------|------------------|------------------|-------------------|-----------------|
| **Total**                |                  |                  |                   |                 |
| Treatment dummy: 5 km or more from the health center | 0.961            | 0.990            | 0.975             | 0.986           |
|                          | (0.000)***       | (0.492)          | (0.000)***        | (0.067)         |
| Observation              | 13291            | 13291            | 17850             | 17878           |
| **South**                |                  |                  |                   |                 |
| Treatment dummy: 5 km or more from the health center | 0.976            | 1.016            | 0.994             | 0.997           |
|                          | (0.076)          | (0.481)          | (0.432)           | (0.746)         |
| Observation              | 7357             | 7357             | 9963              | 9977            |
| **North**                |                  |                  |                   |                 |
| Treatment dummy: 5 km or more from the health center | 0.967            | 0.993            | 0.952             | 0.960           |
|                          | (0.013)*         | (0.706)          | (0.000)***        | (0.001)**       |
| Observation              | 5934             | 5934             | 7887              | 7901            |

Odds ratios (ORs) are reported, *p < 0.05 **p < 0.01 ***p < 0.001, p-values in brackets

**Discussion**

We analyzed the effects of geographical access to health facilities on the use of maternal healthcare services in Benin utilizing a national-representative sample from two rounds of DHS datasets along with GIS data on health center locations. We confirmed that distance from residential area to the closest health center, after controlling for potential confounders, had negative effects on the use of appropriate healthcare for pregnancy and childbirth except for at least four ANCs. This adverse effect of distance on maternal healthcare utilization is consistent with the results of numerous previous studies in Sub-Saharan African countries (10, 11, 21–23).

There are three points to be discussed here. First, although we confirmed the adverse effect of distance on maternal healthcare utilization in Benin, this effect was mainly observed in the northern part. It is recognized that the north of Benin is more rural and less equipped with health infrastructure than the South. For instance, three departments in the southern part—Atlantique, Ouémé, and Littoral—encompass 48 percent of all 1,155 private health facilities in the country (24). Thus, expecting women in South generally have easier access to maternal healthcare compared to their counterparts in the North. Conversely, the average distance to the closest health center was longer, and the percentage of women using appropriate maternal health care was actually lower in the North (Table 1). Thus, geographical access to health facilities becomes critically important to access the necessary maternal healthcare in the North. A previous study conducted in Benin found consistent difficulties in accessing maternal healthcare among women in rural areas compared to urban areas (6).
In general, the negative impact of distance on healthcare utilization increases when it is combined with a lack of transportation in developing countries (25, 26). Regarding means of transport, Table 1 shows that the community's ownership rates of bicycles and motorbikes were higher in the North than in the South, implying that these vehicles are more common transport means for people in the northern part. The results of the logistic regressions showed that the ownership rate of motorbikes had positive effects on women's uptake of facility delivery and SBA in the North (Table 2). Since a higher ownership rate of motorbikes per cluster also indicates better road conditions of the community, transport infrastructure is critical for women's use of appropriate maternal healthcare. Previous studies in Mali and Nepal showed similar results in that poor road conditions reduced the likelihood of receiving timely ANC (27, 28).

Second, our finding that distance to health facilities had a negative effect on the use of at least one ANC but no effect for four or more ANCs is consistent with previous studies in Tanzania (29), Zambia (30), and Ethiopia (31). However, other empirical studies conducted in many African countries found adverse effects of distance on women's uptake of four ANC visits (23). Regarding this, empirical studies in Nigeria (32) and other low- and middle-income countries (33), reported that regardless of distance, absence of good medication and health workers, disparity between the nature of antenatal provision and the expectations of the women prevent women's uptake of ANC. In Benin, the persistent shortage of healthcare workers leads to low performance of health facilities and quality of healthcare (12, 34), leading to lowered motivation to go to healthcare facilities. Thus, policy interventions should target the demand and supply sides of maternal healthcare. Particularly, efforts should be made to provide a healthcare system with qualified and sufficient workers.

Third, regarding the threshold of distance, our PSM analysis confirmed that women living within 5 km from the closest health center were more likely to use maternal healthcare compared to their counterparts. This result is consistent with the systematic review of 31 empirical studies that showed that living within 5 km of obstetrical facilities was significantly associated with a higher likelihood of delivering a baby at a health facility (26). A study in Haiti also showed that the availability of health centers within 5 km of a residence increased the odds of receiving ANC services (35). Our study confirmed the appropriateness of the definition of “geographical accessibility to healthcare” by Benin's NHDP 2009–2018 as the percentage of the population living within 5 km from the closest health center (20).

Conclusions

We confirmed that the distance from one's residence to the closest health center had a significant negative effect on women's use of appropriate maternal healthcare, mainly in the northern part of Benin. Geographical accessibility to health facilities is critical for improving the use of appropriate maternal healthcare. Investment in transport infrastructure should be prioritized for further improvements in the MCH.

Abbreviations

ANC: Antenatal care; BDHS: Benin Demographic and Health Survey; GIS: Geographic Information System; MCH: Maternal and child health; NHDP: National Health Development Plan; OR: odds ratio; PSM: propensity score matching; SBA: Skilled birth attendant; WHO: World Health Organization

Declarations

Ethics approval and consent to participate

This study is a secondary analysis of anonymous data from the Demographic and Health Surveys of Benin. The survey was approved by the Benin' National Statistics Council and National Ethics Committee for Health Research. Prior to the questionnaire survey, written informed consent was obtained from all adult respondents or from parents/guardian for minors.

Consent for publication

Not applicable

Availability of data and materials

The dataset used during the current study are in the public domain and can be obtained from the DHS Program (http://dhsprogram.com//) or from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions


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