Geographic access and maternal health services utilization in Sélingué Health District, Mali.

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Abstract

Introduction. Maternal mortality is one of the main causes of death for women of childbearing age in Mali, and improving this outcome is slow, even in high geographic-access regions. Disparities in maternal health services utilization can constitute a major obstacle in the reduction of maternal mortality and denotes a lack of equity in the Malian health system.

Literature on maternal health inequity has explored structural and individual factors influencing outcomes but has not examined inequities in health facility distribution within moderate geographic access districts in Mali. The purpose of this article is to examine disparities in education and geographic distance and how they affect utilization of maternal care within the Sélingué health district, a district with moderate geographic access to care, near Bamako, Mali.

Methods. We conducted a cross sectional survey with cluster sampling in the Sélingué health district. Maternal health services characteristics and indicators were described. Association between dependent and independent variables was verified using Kendall's tau-b correlation, Chi square, logistic regression with odds ratio and 95% confidence interval. Gini index and concentration curve were used to measure inequity.

Results. The majority of the participants were 20 to 24 years old. Over 68% of our sample had some education, 65% completed at least four ANC visits, and 60.8% delivered at a health facility. Despite this evidence of healthcare access in Sélingué, disparities within the health district impede the other roughly 40% of our sample from utilizing maternal healthcare. The concentration index demonstrated the impact of inequity in geographic access comparing women residing near and far from the referral care facility.

Conclusion. Maternal health services underutilization, within a district with moderate geographic access, indicates that deliberate attention should be paid to addressing geographic access even in such a district.

French Version Of The Abstract.

Résumé

Introduction. Les disparités dans l'utilisation des services de santé maternelle peuvent constituer un obstacle majeur à la réduction de la mortalité maternelle et dénotent un manque d'équité dans le système de santé malien.

La littérature sur les inégalités en matière de santé maternelle a exploré les facteurs structurels et individuels qui influencent les résultats, mais n'a pas examiné les inégalités dans la répartition des établissements de santé au Mali. L'objectif est d'examiner les disparités en matière d'éducation et de distance géographique et leurs influences dans l'utilisation des soins maternels dans le district sanitaire de Sélingué.

Méthodes. Nous avons utilisé une enquête transversale avec échantillonnage en grappes dans le district sanitaire de Sélingué. Les caractéristiques et les indicateurs des services de santé maternelle ont été décrits. L'association entre les variables dépendantes et indépendantes a été vérifiée en utilisant la corrélation tau-b de Kendall, le Chi carré, la régression logistique avec odds ratio et un intervalle de confiance de 95%. L'indice de Gini et la courbe de concentration ont été utilisés pour mesurer l'iniquité.

Résultats. La majorité des participantes étaient âgées de 20 à 24 ans. Plus de 68% ont une certaine éducation, 65% ont effectué au moins quatre visites prénatales, et 60,8% ont accouché dans un établissement de santé. Malgré cette preuve d'accès aux soins à Sélingué, les disparités au sein du district sanitaire empêchent les autres 40% de recourir aux soins. L'indice de concentration a montré des preuves d'inégalité entre les femmes résidant près d'un établissement de santé et celles éloignées d'un établissement de santé.

Conclusion. La sous-utilisation des services de santé maternelle indique qu'il faut identifier les besoins et les cibles des interventions, et de veiller délibérément à répartir équitablement les établissements à l'intérieur des districts sanitaires. Plus une femme vit loin d'un établissement de santé, moins elle utilisera les services de santé, Ce facteur géographique qui affecte l'accès et l'utilisation des soins de santé est un exemple de besoin identifié. Une amélioration des indicateurs de soins n'implique pas l'équité dans la distribution des soins.

Mots-clés. Inégalité, quatre CPN, accouchement dans un établissement de santé, distance.

Introduction

The African continent faces some of the highest rates of maternal mortality in the world, and maternal mortality is the leading cause of death in women of reproductive age in Mali. The largest cause of maternal death in Mali is hemorrhage; hemorrhage and obstructed labor require immediate attention. Women with severe anemia cannot afford to lose much blood before they go into shock, as they are starting off with lower hemoglobin levels [1]. This shortens the time they have to reach a referral facility, making a long delay to receiving care particularly deadly. Hemorrhage, toxemia in pregnancy, and infection account for 80% of all direct causes of maternal mortality; prompt medical care can prevent mortality in almost all cases [2]. After 2000, national-level estimates of the maternal mortality ratio began to decrease in Mali, dropping from 464 to 325 deaths per 100,000 live births between 2000 and 2018[3-5]. However, this sharp decline obscures much higher levels in more remote rural areas. A 2011 study showed that the maternal mortality ratio can be far higher in rural Mali than estimates based on nationally representative samples [6]. Social-systemic factors contributing to the "neglected tragedy" of maternal mortality are inadequate access to care, under-utilization of modern healthcare services, and women's decision-making power, often linked to their education level [7].

Geographic access to care is a major factor contributing to maternal mortality, given that many life-saving interventions like caesarian sections and blood transfusions are only available at referral health facilities. In a secondary analysis of census data from rural areas of Tanzania, large distances to

hospitals contribute to high levels of direct obstetric mortality. Deaths due to direct causes of maternal mortality were strongly related to distance from a health facility, with mortality increasing from 111 per 100,000 live births among women who lived within five km to 422 deaths per 100,000 live births among those who lived more than 35 km from a hospital [8]. Other causes of delay relating to low-income or geographically remote regions can be attributed to poor roads, lack of available vehicles, and transportation costs [9]. Even with coordinated transportation, long distances from remote regions to a health facility are themselves another delay, as the distance to travel to a facility may take multiple hours or even days. Unlike antenatal care (ANC) visits, emergency care during labor and delivery cannot always be planned, and this delay can make childbirth in a facility highly unlikely. This geographic barrier is represented by the second delay in the three delays model: 1) delays on decision making, 2) delays in reaching health facilities, and 3) delays in receiving appropriate care [10].

The underutilization of ANC is another key factor impacting maternal mortality. Women in Mali do not initiate ANC visits early enough in their pregnancy. Furthermore, in maternal emergencies, they may not seek care from a health facility at all. According to a systematic review by Peters et al., access barriers can be identified in four dimensions, encompassing shortages in supply and demand: geographic accessibility, availability, affordability, and acceptability [11] For maternal mortality, factors associated with the use of ANC and delivery services are education, cost, quality of care, and access to services [7]. These factors align with the categories of Peter et al.'s four dimensions of barriers to health services, acceptability, affordability, availability, and geographic accessibility, respectively. Within this framework, this paper focuses on variations and equity in geographic access, in a district with moderate geographic access (compact district, close to the capital city of Bamako), compared to most other districts located farther from the capital.

Women's decision-making power is the third key factor that will be discussed. Women's autonomy increases directly as a function of their years of completed education and literacy, the cornerstone of sustainable development [12]. More educated women delay marriage and childbearing, are more likely to use modern contraceptives, and thus are at less risk for pregnancy and maternal mortality [13]. In a large-scale randomized study on adults who completed an adult based education (ABE), there was a significant drop in infant and maternal mortality among women of the same wealth group compared to those who had never completed ABE [14]. There is substantial evidence going back decades that supports the fact that education and female literacy allows women to make better health decisions for themselves and their children, including accessing healthcare services such as vaccinations, contraception, childbirth, and postpartum care [14]. Women's autonomy mostly directly affects the first of the 3-delays to seeking care: delays on decision making to seek care [10].

Throughout existing systematic analyses and reviews, the unequal distribution of healthcare facilities throughout low geographic access areas of high geographic access districts is rarely discussed. High geographic access areas and moderate geographic access areas have lower maternal mortality compared to the most low geographic access areas [6]. Understandably, this leads programs to focus more on these very remote, low geographic access areas. Despite this need, maternal health programs

cannot forego efforts to improve access in assumed moderate geographic access areas since the geographic distribution of those facilities in these regions, and women's access to them, is still inequitable. Simply constructing more health facilities within a district may not be sufficient [15]. Geographic access to health facilities is often overestimated due to the assumption that people always elect to go to their closest healthcare facility and that they travel in a straight line to that facility [15]. One reason to not seek care from the closest facility may be vacant posts or poor quality care in the closest facility. A study in Kenya simulated the ease or difficulty of physical access to government health facilities through a GIS algorithm. Even within urban, high geographic access regions of Kenya, it was found that about four million people did not live as close to healthcare facilities as previously assumed [15]. Barriers such as difficult terrain, and variation in services offered and quality of care from one facility compared to another illustrate that access varies more than just proximity to a facility on a map.

Gaps in education and distance from the facility are well documented as factors affecting ANC utilization and birth in healthcare facilities [7, 16]. These factors are well-known, yet it is unclear how geographic access varies within districts, and how that affects maternal health equity and healthcare utilization and access. Sections of Mali are categorized as high, moderate and low geographic access, and within these high geographic access locations entire districts are designated as having high, moderate or low access to maternal healthcare facilities. Areas are considered to have low geographic access largely by their population density [17]. Despite entire urban districts classified as having moderate geographic access to maternal healthcare facilities, inequity in access persists. However, there have not been analyses on the disparities that exist within areas classified as having moderate geographic access, and their corresponding variability of healthcare utilization.

This study examines maternal healthcare utilization within the Selingué health district, a district with moderate geographic access. We examine two main social determinants of health services utilization: education and geographic distance from a healthcare facility. This research applied tools for analysis of equity in healthcare to examine disparities in education and geographic distance and how they affect access to maternal care throughout the health district of Sélingué.

Methods

Data Collection

The study was conducted in the health district of Sélingué, located 145 kilometers southwest of Bamako. A health district is a geographic zone defined by the Malian government to provide public and private integrated healthcare as well as supported services (laboratories, logistics, etc.). The study district is made up of 60 villages with a total of 91,425 inhabitants, and it is divided into seven sub-districts. Each sub-district has a community health center where women receive their antenatal and maternal care. The one referral care facility, the district hospital, is staffed by one or more physicians, while the sub-district health centers are run by a center technical director, usually a nurse, with the exceptions of Siékorolé and

Diarani, where the health center is run by a physician. We conducted a cross-sectional survey with cluster sampling proportional to village population size at two levels.

We implemented a cross sectional study design with two levels of cluster sampling, for a total of 30 clusters. The first stage was the randomized selection of the seven sub-districts, then the random selection of the villages within the chosen sub-districts. At the last stage, we conducted random sampling to select the families in the village that included at least one eligible woman. Women were eligible to participate in the study if:

- They gave voluntary, free, and informed consent to participate in the study.
- They had given birth in the 12 months prior to the day of the survey, regardless of the outcome of the pregnancy, in accordance with the Demographic and Health Survey [3].
- They had been residing in the randomly selected area for at least six months prior to the day of the survey.

The number of clusters per village depended on the population size. Thus, villages with a relatively high population had more clusters than villages with a lower population. In total, we selected 960 households, or 33 households per cluster, with at least one eligible woman in each household.

The protocol was approved by the Institutional Review Board of the Johns Hopkins Bloomberg School of Public Health of Baltimore, and the Faculty of Medicine and Pharmacy at the University of Sciences, Techniques and Technologies of Bamako. Physical risks to study participants were negligible. Overall, this was a minimal risk study that did not involve any administration of medications or other substances, medical or surgical procedures, and no biological samples were collected. All investigators were trained in data collection techniques, including a module on the protection of human subjects, informed consent, and maintaining confidentiality. A written consent form was signed and dated by interviewees and the investigators.

We conducted face-to-face interviews using a questionnaire. All investigators were trained in data collection techniques including a module on the protection of human subjects, informed consent and maintaining confidentiality. We collected data on the age of the women, the level of instruction, the parity, the distance between the village and the health facility, the number of ANC visits and the age of pregnancy at the first ANC visit.

Data was collected with Samsung Galaxy tablets, sent to an online server (Magpiand extracted using Microsoft Excel. We established a standardized description of the characteristics and indicators of maternal health service utilization. After quality control and correction, excel spreadsheets were merged into a single SPSS database.

According to the Mali 2018 National Health Information System, 57% of the population is within five km of a health facility [18], however, we classified geographic access areas in these following three categories:

- High geographic access areas: At least 75% of the population is within five km of a health facility
- Moderate geographic access areas: from 50 to 74% of the population is within five km of a health facility
- Low geographic access areas where less than 50% of the population is within five km of a health facility

Data Analysis

We performed an analysis between dependent and independent variables using simple and multiple logistic regression Chi-square tests to measure the determinants of service utilization. The gross and adjusted odd ratios were calculated with a 95% confidence interval and a p-value of 0.05% for a significant difference. We verified the association between dependent variables and independent variables that have more than two modalities by using Kendall's tau-b correlation. Variables that had a significant association during bivariate analysis were put into the model.

To measure equity in geographic access, we calculated the Gini index and constructed a concentration curve. The concentration curve presents a visual graph of inequity in the use of health care and compares the level of inequity over distance. The Gini index is a quantitative measure of inequity in the use of healthcare, defined as "twice the area between the concentration curve and the equity line, to measure the degree of inequity systematically associated with distance" [19]. These two methods are standard measures to estimate inequity related to a variable on various health indicators [9]. We interpreted the inequity measured through the concentration curve and the concentration index as horizontal inequity, since all women were assumed to have the same maternal health needs, e.g. need for delivery in a referral care health facility, regardless of baseline characteristics [20]. While the concentration curve is a useful tool for graphically representing inequity, it does not quantify the magnitude of the inequity.

Economic status was measured using the wealth index model taken from the Bangladesh Demographic and Health Survey [21]. Geographic accessibility was estimated using the index of distance between a women's village of residence and local health facilities by using the concentration curve and the concentration index (distance index from place of residence to health facility). This index places women's villages of residence individually on a continuous scale of relative distance. Five quintiles of distance were used to categorize distance of the women to their health facility and to measure its influence on their maternal health indicators. Both principal component and factor analysis were carried out [22]. The value of the concentration index is between -1 and +1. A value of 0 indicates that the use of health services is equitably distributed among socio-economic groups. The value of the distance index below zero indicates that women in remote places of residence use more health facilities than women in areas

further from health facilities. A value above zero implies that women residing furthest from a facility use health services more than women who reside closer [19].

Results

Table 1 provides an overview of the socio-demographic characteristics of women of childbearing age in Sélingué. In Table 1, young women in the 20 to 24-year age group were the most represented in the sample. Three-quarters of women reside in villages within five km of a first-level health facility, the majority of women in this study (68.7%) have no education at all, and 61% of women have at least three children.

Table 1
Sociodemographic characteristics of women of childbearing age in Sélingué District, Mali

Sociodemographic variables	n	%
Age intervals (years)	**1021**	
15−19	247	24.2
20−24	268	26.2
25−29	212	20.8
30−34	154	15.1
35−39	103	10.1
40−49	37	3.6
Level of education	**1021**	
No formal instruction	701	60.7
Primary Schooling	213	20.9
Second level of primary school	88	8.6
At least secondary level	19	1.9
Parity	**1021**	
Primiparity	199	19.5
Second parity	197	19.3
Multiparity	625	61.2
Geographic access		
Distance from village of residence to first-level health facility	**1021**	
0−5 km	749	73.4
6−15 km	169	16.6
>15 km	103	10.1
Distance from nearest first-level health facility to referral hospital.	**1021**	
0−5 km	219	21.4
6−15 km	210	20.6
>15 km	592	58.0

In both Tables 2 and 3, data indicate that women living in villages between 6 to 15 km from a community health facility are 50% less likely to achieve four or more ANC visits during pregnancy and 80% less likely to deliver in a health facility compared to women residing in villages located within five km of a community health facility (p < 0.001). Women residing in villages more than 15 km from a community health facility are 40% less likely to achieve four or more ANC visits throughout pregnancy and are 90% less likely to deliver in a community health facility, compared to those residing in villages within five km of a first-level health facility (p < 0.05).

Table 2
Women with at least four ANC visits with geographic accessibility and individual characteristics

Characteristics	N	At least four ANC visits		% Yes	OR (CI 95%)
		Yes (n)	No (n)		
Gestational age at first ANC visit	876	656	220	55.3	1
5 months and more	320	177	143	86.2	5.0*** (3.627–6.965)
4 months or less	556	479	77		
Distance from village to first-level health facility	896	666	230	77.9	1
0−5 km	678	528	150	61.6	0.5*** (0.309; 0.672)
6−15 km	138	85	53	66.2	0.6* (0.339; 0.917)
>15 km	80	53	27		
*= p < 0,05; **= p < 0,01; ***= p < 0,001.					

Table 3
Health facility delivery comparing instruction level and distance to first-level health facility.

Characteristics	N	Health Facility Delivery		% Yes	OR (CI 95%)
		Yes (n)	No (n)		
Instruction level	1021	405	296	86.4	1
No formal instruction	701	145	68	68.1	**1.6** (1.113; 2.16)
Primary School	213	84	4	68.1	**1.2 (0.74; 1.99)**
Second-level of primary school	88	11	8	57.9	
At least secondary level	19				0.6 (0.25 ; 1.65)-
Distance from village to first level of health facility.	1021	535	214	71.4	1
0−5 km					
6−15 km					
>15 km					
		749	62	107	36.7	0.2*** (0.16; 0.33)
		169	24	79	23.3	0.1*** (0.07; 0.19)
		103				

*= p < 0,05; **= p < 0,01; ***= p < 0,001.

Table 2 reveals that women who started their first ANC visit at four months or less of pregnancy are five times more likely to have four or more ANC visits during their entire pregnancy, compared to women who started the first ANC at five months or more of pregnancy (p < 0.001).

Table 3 presents the odds ratio of health facility delivery with women's education levels and distance from a health facility. Women with up to six years of primary education are twice as likely to give birth in a health facility, compared to women with no education (p <0.01). Women with six to nine years of education are 3.3 times more likely to give birth in a health facility compared to those with no education (p<0.05).

Figure 1 shows that completion of four or more ANC visits during pregnancy is unequally distributed in favor of women from villages closest to a health facility. The farther the curve deviates from the perfect equity line, the greater the degree of inequity. In both Figures 1 and 2, the concentration curve is below the equity line. Figure 2 shows that delivery in a health facility is also unequally distributed, in favor of women who reside in villages closest to a health facility.

Discussion

The sixth Demographic and Health Survey in Mali reports an increase in four or more ANC visits over the past two decades: from 43% of women in 2001 to 68% in 2018. Furthermore, considerable progress has been made for the percentage of live birth deliveries in a health facility, increasing from 38–67% in the same time period [3]. Despite these improvements in healthcare utilization, maternal mortality remains a major cause of death among Malian women [3].

The district of Sélingué is about 1.5 hours away from the capitol of Bamako, and there is overall moderate geographic access to healthcare facilities. However, even within Sélingué, there is variation that has real impacts on usage of maternal healthcare and facilities.

Access to care and the underutilization of healthcare are key factors that impact maternal mortality [7]. Yet in the health district of Sélingué, close to the national capital, with moderate geographic access to health services, there are clear disparities within the district. As noted in existing studies, the unequal distribution of healthcare facilities according his geographical accessibility in West African regions is rarely discussed [23–26]. The internal disparities identified in this paper provide insight into why some women still experience poor maternal healthcare utilization and access, despite living in moderate geographic access regions of Mali. As depicted in Figs. 1, 2 and 3, the concentration curve demonstrates a lack of equity of access to delivery by healthcare facility and for women receiving four ANC visits. Gaps in education and distance from the facility are well documented as factors affecting ANC utilization and birth in healthcare facilities [7, 13, 27]. However, the provided data highlights how geographic access varies within this moderate access district, and how that affects maternal health equity and utilization access in Sélingué.

Women still face substantial barriers in the health district of Sélingué, despite this region having many health facilities. The distribution of these health facilities is not conducive to the equitable access of healthcare by all women in the district. A sizeable portion are still not delivering in a health facility or receiving ANC, and this is based on their distance from the facility, among other social factors.

Completion of a woman's first ANC visit in the earliest stages of her pregnancy (the first four months) is significantly associated with the completion of four or more ANC visits. Additionally, older pregnant women are more likely to complete four ANC visits. In addition to this timing, distance represents further disparity. The chance for a pregnant woman to have four or more prenatal visits decreases beyond a distance of 15 km between her home and a first-level health facility. As the distance between the health facility and a woman's village of residence decreased, her likelihood of attending four ANC visits increased.

The importance of evenly distributed health care facilities within moderate geographic access areas should not be neglected simply because they already have better access than low geographic access regions. The data tables demonstrate that if women living in villages between six to 15 kilometers from a community health facility, they are 50% less likely to achieve four or more ANC visits during pregnancy

and 80% less likely to deliver in a health facility [Table 2, Table 3]. Distributing health facilities more equally, or other efforts to bring care closer to women, can improve ANC services utilization in these more moderate geographic access areas. The findings reinforce that addressing utilization barriers is necessary in order to comply with the WHO recommendations for achievement of four or more ANC visits, facilitating childbirth in a health facility, and promoting equitable distribution of maternal health care and services [28].

In addition to even facility distribution, attention should be given to gender equality and women's unequal access to education. A study completed by Ahmed et al., describes a concept similar to the 3-delays model but called the 3-Es [29]. This study recognizes a woman's economic, education, and empowerment status as key indicators to maternal healthcare utilization [29]. Similar to the 3-delays (delays in seeking care, delays in arriving at the health facility, and delays to being provided care), there are inequities in the 3-Es. As supported in our data, women who are experiencing inequities in our education variable have lower healthcare service utilization (Table 3). Our data points to the larger socio-structural disadvantages that women face, and must be addressed country-wide, not only in Sélingué, to see long-term progress in women's maternal health. Efforts and interventions should be centered around gender equality by virtue of girl's education to improve women's overall maternal health as well as increase their utilization of health services.

Attention must continue to be placed in moderate geographic access areas such as the health district of Sélingué. Interventions should focus on addressing the determinants of the usage of equitable maternal healthcare, such as the *3-Es* and distance. Addressing these inequities will position Mali to be capable of achieving the third Sustainable Development Goal: to ensure healthy lives and promote wellbeing for all, at all ages.

Our results align with previous studies that show higher educational attainment as significant in influencing birth in a health facility [27, 30]. Additionally, distance beyond five km of a health facility was significantly associated with a decrease in health facility utilization. There are some studies that contrast with our findings in their analysis of inequalities in the use of maternal care. In a range of low- and middle-income countries (LMICs), with particular attention to the low geographic access, moderate and high geographic access areas disparities, the association between place of residence and receipt of early ANC was not consistent [16]. Some LMICs, like India, did not show a significant difference in ANC when comparing high geographic access areas and low geographic access areas with respect to their distance from health facility. However, it stands undisputed that antenatal care, childbirth, and postpartum care provided by a health facility are key factors in preventing maternal and neonatal mortality [3].

Study Strengths and Weaknesses

This research was conducted as a cross-sectional study with a retrospective survey. In this type of study design, there is a possibility for recall biases in our survey response subjects, which may affect our results of care-seeking behaviors. Additionally, a selection bias may also be at play since women who died during pregnancy, labor, or delivery before the survey was conducted were not included in the analysis.

Suggestions for Further Research

More research and in-depth assessments are needed to better address the interactions of these social determinants, and their impact on improving maternal healthcare utilization.

As noted in similar studies and systematic reviews, some countries of similar income levels do not see as stark disparities as Sélingué, Mali [16]. If their inferences are true, possible points of additional research can be to articulate what allows for the mediation of these disparities. Particularly, what interventions, programs, or data is necessary to ensure a more equitable distribution of healthcare facilities and services in moderate geographic access-classified areas. Other questions surround the impact of community-based transport systems and the construction of more referral care facilities that indirectly or directly impact the use of maternal health care.

During our proposal writing, we carried out an exchange visit to assess an obstetric emergency transportation system from villages to community health center delivered in the Diema health district. Data analysis showed that the obstetric emergency transportation system from villages to community health center can improve the use of delivery at health facilities.

Conclusion

This study analyzed the determinants of equity in the use of maternal health care in the Sélingué health district in Mali. Some studies assessed maternal health disparities associated with wealth index, maternal level of education, place of residence and administrative region [16], but rarely on disparities of maternal health services utilization associated with distance quintile in moderate geographic access regions.

In conclusion, our findings suggest that interventions and resources for gender equality and health facility access should be reallocated, with emphasis on their even distribution within the target area. Although there is critical need for greater health facility coverage in low geographic access areas, moderate and high geographic access   areas also face disparities due to uneven access to facilities. The 3-Es framework points to the value of supporting gender equality through social-structural changes improving maternal health indicators is not enough [29]. In achieving the Sustainable Development Goals, it is necessary to:

- Improve the school enrollment rate of girls in low and moderate geographic access areas.
- Improve the coverage rate of maternal health care while reducing the distance of 15 km between villages and health facilities, especially in moderate geographic access areas.

With the support of many studies, including our own findings, the systemic benefits of increasing women's education and geographic distribution of facilities will result in improved maternal health and

healthcare utilization, as well as economic mobility and thus large-scale social benefits [29].

Declarations

Ethics approval and consent to participate

Ethics approval was received from the Faculty of Medicine and Odonto stomatology at the University of Sciences, Techniques and Technology of Bamako, Mali (REB number: 2015/ 112 /GE/FMPOS).

Consent for publication: Not Applicable

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors state that they have no competing interests.

Authors' contributions:

Tounkara M prepared the first draft of the manuscript. All authors critically reviewed manuscript drafts.

Abbreviations

ANC - antenatal care

ABE - adult based education

3-Es - woman's economic, education and empowerment status.

LMICs - low- and middle-income countries

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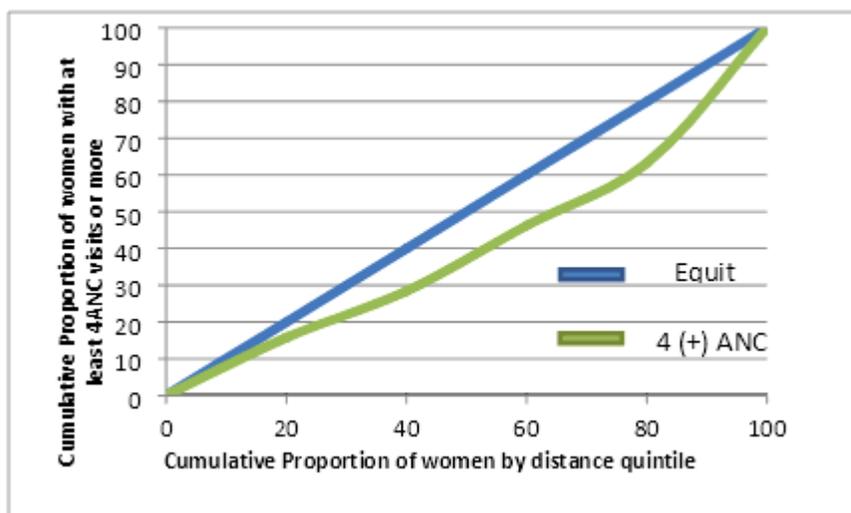
Figures

Figure 1

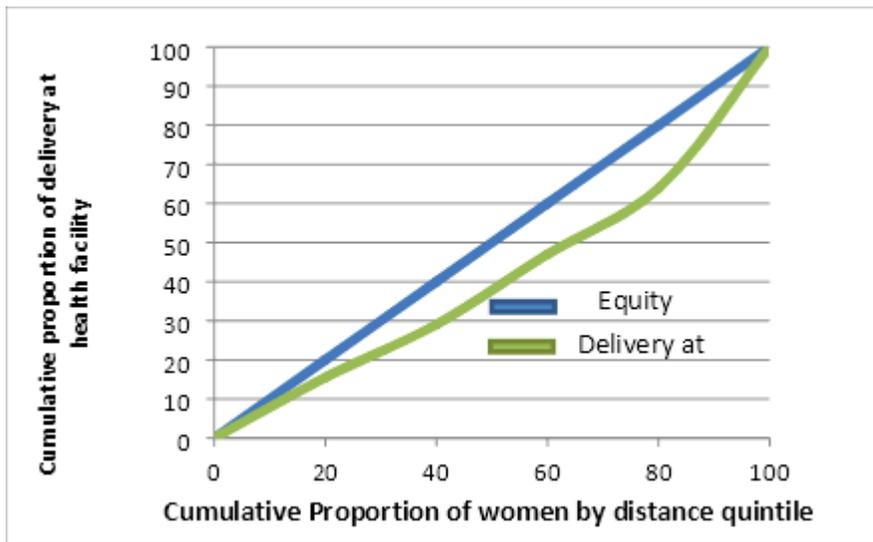Concentration curves of maternal health services utilization: Concentration curve of four or more ANC visits

Figure 2

Concentration curves of maternal health services utilization: Concentration curve of delivery at health facility
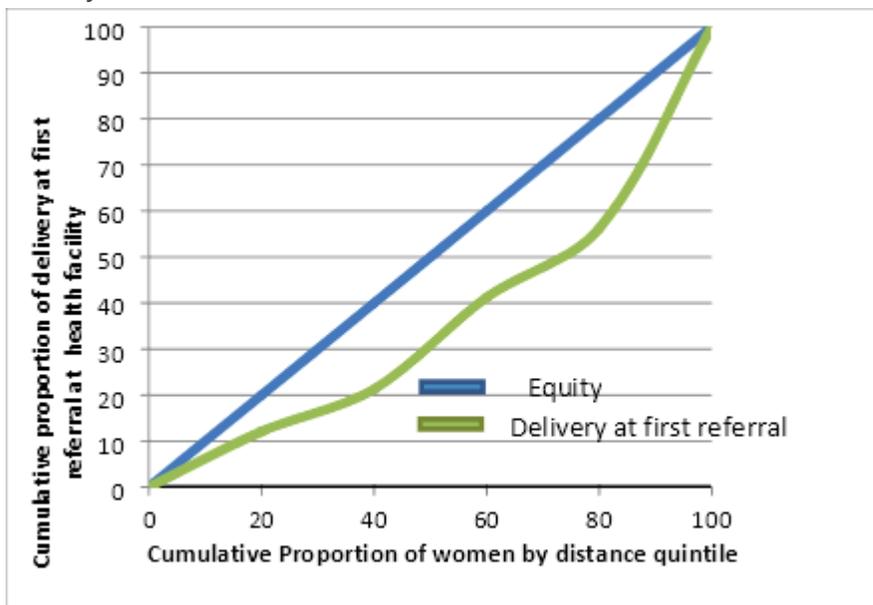

Figure 3

Concentration curves of maternal health services utilization: Concentration curve of delivery at first referral of health facility