

Inequalities in effective Access to Obstetric Care in Chad

Eric Allara Ngaba[†] and Benjamin Fomba Kamga[‡]

Abstract

This paper aims to fill the gap in the literature regarding the inequalities in effective access to obstetric care in Chad by introducing the decomposition of antenatal care (ANC) consultation in a comprehensive model of obstetric care. The methodology used is the regression decomposition approach in addition to the Probit and negative Binomial Law. The results show that there are significant factors of inequality in effective access to obstetric care. The factors that contribute most to these inequalities are the income of women's well-being, place of residence and level of education. Combating income inequality, promoting equitable education, and subsidizing transport resources can make the health care system more equitable and significantly reduce unfair inequalities in access to obstetric care. Based on the findings of this study, we propose areas for future research. For instance, it would be interesting to examine women's treatment pathways in their health seeking behaviour. This will make it possible to see women's preference in effective access to obstetric care in Chad.

Keywords: Chad, decomposition, Inequalities in access, obstetric care

JEL Classification Codes : I14, C13, C25

[†] Corresponding Author, Office of the Executive Secretary (OES) United Nations Economic Commission for Africa (UNECA), Addis Ababa, Ethiopia and Department of Economics, University of N'Djamena, Chad. Email eric.allarangaba@un.org, allara.ngaba@yahoo.fr

[‡] Associate Professor in Economics, University of Yaounde II-Soa, Cameroon

1 Introduction

Disparities in the risk of maternal mortality between and within countries and among social groups remains a major global health concern, despite large-scale¹ programmatic interventions over the past two decades. Indeed, of the total maternal deaths² in 2015, 99.43% occurred in the developing countries, with sub-Saharan Africa and South Asia alone accounting for 86.99% of the total deaths. In Chad in 2016, maternal mortality accounted for 45% of all deaths among women of reproductive age, with a rate of 1,140 per 100,000 live births disproportionately distributed among social groups. These clear variations in maternal mortality, beyond the non-preventable causes, are attributable to inequalities in access to maternal health care such as antenatal care, safe delivery and postnatal care at various economic, geographic and social levels (Mohanty and Pathak 2009; Say and Raine 2007). In this perspective, a study by Mutangadura et al. (2009) on the dynamics of inequalities in access to maternal health services for a panel of ten African countries reveals that these inequalities are in favor of the rich. Furthermore, it mentions that Chad not only has a high level of inequalities compared to other countries, but also that inequalities have been increasing over time as Chad committed itself in 2001 to the Millennium Development Goals (MDGs) and in 2004 it became an oil exporting country. In the MDGs, a special place is given to maternal health because it is part of intergenerational altruism. With the adoption of the MDGs and then Sustainable Development Goals (SDGs), the place accorded to maternal health is still being updated. Therefore, antenatal care, safe delivery and postnatal care strengthen the management and prompt treatment of pregnancy-related complications to reduce maternal mortality. This care plays a crucial role in ensuring the health of the baby and the mother during the maternity period. On this basis, understanding the factors contributing to inequalities in access to maternal health care is important for public health policy intervention.

The existing literature on inequalities in effective access to obstetric care shows that these inequalities can be justified by health care needs and those that do not depend on these needs are unjustifiable (Huda et al. 2018). Inequalities in effective access to obstetric care services that may arise from the interaction between supply and demand (Tchicaya and Lorenz 2011) should then be expected to be need-based and to evolve in accordance with needs to be qualified as fair. Yet there are huge disparities in coverage of maternal and child health services between the haves and have-nots in low-income countries (Gwatkin et al. 2004). Studies in this regard link, among other things, wealth (Fenny et al. 2019), place of residence (Say and Raine 2007), maternal education (Pallikadavath et al. 2004), female age (Magadi et al. 2007), religion (Gyimah et al. 2006), spousal education and women's autonomy (Joshi et al. 2014).

The most recent of these empirical studies (Ali and Chauhan 2020; De La Torre et al. 2018; Presty et al. 2015), which have highlighted three indicators of obstetric care, namely complete antenatal care³, safe delivery and postnatal care, do not claim to be exhaustive. On the other hand, Nwosu and Ataguba (2019) disaggregated antenatal care in the absence of contact with health personnel, complete antenatal care, and the intensity of antenatal care in addition to not introducing a

¹ These are, on the one hand, the Millennium Development Goals and, on the other hand, the Sustainable Development Goals, which contain within them the targets to be achieved in relation to maternal mortality.

² The proportions of maternal deaths are estimated by the author using World Bank data based on the classification of countries into developing world (low-income and middle-income countries) but also by regional grouping as sub-Saharan Africa and South Asia.

³ According to the WHO, the antenatal care consultation is complete when the woman has four consultations during pregnancy.

comprehensive model of obstetric care. Furthermore, Nadjiroum (2007), which sought to understand the reasons why some women who have had at least one prenatal consultation care do not receive qualified assistance during childbirth, tells us little about inequalities in effective access to obstetric care in Chad. In the light of all these grey areas, and considering the particular situation in Chad, the objective of this study is to complete the gap in the literature by introducing a relatively more comprehensive model of obstetric which takes care of incomplete, complete antenatal consultation and frequency into the global model of maternal health with regard to the main determinants of inequalities in health care using Chad as a case. In doing this, the study contributes significantly to the literature in the following ways: First, this paper is the first empirical attempt at understanding the factors of inequalities in use of maternal health care in Chad put in the decomposition of antenatal care (ANC) consultation in a comprehensive model of obstetric care. Second, it adopts the regression decomposition approach which allows the study to discover whether the main factors of inequalities come from factors' disparity or factors' effect. Third, it introduces the early and late maternity as risk factors in examining the extent of inequality in Chad.

Using data from Chadian Demographic Health Surveys and Multiple Indicator Cluster (CDHS-MIC) (CDHS-MIC 2014-2015) and Third Survey on Consumption and the Informal Sector in Chad (ECOSIT3) (ECOSIT3 2011), the study finds that, there are significant factors of inequality in effective access to obstetric care. The factors that contribute most to these inequalities are the income of women's well-being, place of residence and level of education. Combating income inequality, promoting equitable education, and subsidizing transport resources can make the health care system more equitable and significantly reduce unfair inequalities in access to obstetric care.

The rest of the paper is organized as follows: Section 2 describes how the model works, defines the variables used for the empirical analysis and announces the data sources. Estimation results are presented in section 3. The last section is devoted to conclusion and policy implications.

2 Methodology

2.1 Measuring Inequalities

This section describes the methodology of the study. Given the objective of this study, we construct the inequality index using the concentration curve. It involves ranking individuals on a benchmark according to a wealth indicator from the lowest to the highest and viewing how concentrated the use of care is in the different parts of this ranking. This are then compared to needs, to make a judgement about whether the system of care is fair. The ideal tool to measure the degree of these concentrations is the concentration index (inequality index). This index is given by the following formulation:

$$IC_T = 1 - 2 \int_0^1 L_T(P) d_p \quad (1)$$

Where $L_T(P)$ denotes the care use concentration curve, i.e. area of concentration and IC_T , the care use concentration index. This index lies between [-1, 1]. It takes the negative value when the concentration is in favor of the poor and the positive value when it favors the rich. On the other hand, any value of the concentration index tending towards zero indicates equal provision of care, and vice versa. However, this Gini index has an imprecise inequality character. The work of

Lerman and Yitzhaki (1989) on the formulation of the Gini index provides a specification on individual data and is more convenient to apply in practice. This specification is as follows:

$$IC_T = \frac{2}{\bar{y}} cov(y_i, R_i) \quad (2)$$

Where \bar{y} represents the average obstetrical care utilization, y_i the uses of care and R_i the level of wealth. This formulation of the concentration index makes it possible to calculate inequality in care use but does not explain it since inequalities in care use depend on other inequalities.

On this basis, Wagstaff et al. (2003) show that health care utilization can be written in a linear and additive form. This makes it possible to consider the different factors explaining it. Thus, the equation for a woman's health care utilization is written as follows:

$$Y_i = \alpha + \sum_k \theta_k W_{ki} + \omega_i \quad \forall i \in [1 \dots n] \text{ and } k \in [1 \dots K] \quad (3)$$

Where W_k are the k variables that explain the consumption or care use behavior of individuals, and the error term corresponding to the part not explained by the independent variables. To distinguish health care need factors from other explanatory factors and to make clear the issue of fairness or unfairness of health care provision, Van Doorslaer et al. (2004) put forth a new formulation as follows:

$$Y_i = \alpha + \sum_p \beta_p X_{pi} + \sum_l \gamma_l Z_{li} + \omega_i \quad \forall i \in [1 \dots n] \text{ and } p, l \in [1 \dots K] \quad (4)$$

The X_p and Z_l are respectively the p need variables and the inequity variables supposed to explain the consumption of care and the error term corresponding to the portion not explained by these variables as well as their parameters. This specification (4) can be rewritten as follows:

$$Y_i = \alpha + \sum_p \beta_p X_{pi} + \sum_q \gamma_q S_{qi} + \sum_r \gamma_r D_{ri} + \omega_i \quad \forall i \in [1 \dots n] \text{ and } p, q, r \in [1 \dots K] \quad (5)$$

Where S , represents the non-need variables related to the supply of maternal health care and D , the non-need variables related to the demand for maternal health care. The result is a concentration index that is written as follows:

$$IC_T = \sum_{p=1} (\frac{\beta_p \bar{X}_p}{\bar{y}}) C_p + \sum_{q=1} (\frac{\gamma_q \bar{S}_q}{\bar{y}}) C_q + \sum_{r=1} (\frac{\gamma_r \bar{D}_r}{\bar{y}}) C_r + \frac{GC_\omega}{\bar{y}} \quad (6)$$

The values in brackets represent the elasticities and broken down as follows: \bar{X}_p , \bar{S}_q and \bar{D}_r and are respectively the average of the explanatory variables X_p , S_q and D_r and \bar{Y} the average of Y_i . Then C_p , C_q and C_r represent respectively the concentration index of need factors, other supply factors and other demand factors, and GC_ω represents the generalized concentration index of error term ω_i with $GC_\omega = \frac{2}{n} \sum_{i=1}^n \omega_i R_i$.

The products of the elasticities (values in brackets) with the factor concentration indices $((\frac{\beta_p \bar{X}_p}{\bar{y}}) C_p, (\frac{\gamma_q \bar{S}_q}{\bar{y}}) C_q, (\frac{\gamma_r \bar{D}_r}{\bar{y}}) C_r)$ represent contributions to inequality.

Elasticities measure the response of variables of interest (dependent variables) to changes (sensitivity) in need factors, non-need factors relative to supply and non-need factors relative to demand. Concentration indices, on the other hand, measure the degree of inequality in the different factors. The contributions to inequality of the different factors depend on the elasticities and degree of inequality of the respective factors. Thus, need factors or non-need, supply factors or non-need, demand factors that are unequally distributed and have a strong influence on the variables of interest will be the main drivers of obstetric care utilization.

Nevertheless, the positive or negative value of the contribution depends on both the sign of the elasticities and the concentration indices. There are four (4) cases: (i) when the positive value contribution includes the negative sign elasticity and the negative sign concentration index, it indicates that women in this category are inclined to use fewer obstetric care services and that the inequality of the determinant, i.e. the characteristic under consideration, is in favor of poor women. (ii) when the positive value contribution includes the positive sign elasticity and the positive sign concentration index, it suggests that women with this characteristic are more likely to use obstetric care services and that the inequality of this characteristic is in favor of wealthy women. (iii) when the negative value contribution includes the positive sign elasticity and the negative sign concentration index, it indicates that women with that characteristic are more likely to use obstetric care services and that the inequality in that characteristic is in favor of poor women. (iv) when the negative value contribution includes the negative sign elasticity and the positive sign concentration index, it implies that women of the characteristic under consideration are inclined to lower use of obstetric care services and that the inequality of the characteristic is in favor of rich women.

2.2 Econometric estimation methods to obtain the predicted probabilities

The probit model is associated with the decomposition technique to estimate the decision of whether women use obstetric care and the negative binomial law model to estimate the frequency of use of this care.

2.2.1 Binary Probit

In this model, the dependent variables are binary and giving by:

$$\begin{cases} 1 & \text{if Woman use the obstetric care} \\ 0 & \text{Otherwise} \end{cases} \quad (7)$$

Thus, the probability distribution of incomplete ANC, complete ANC, safe delivery, and postnatal care Y_i conditional on the explanatory variables X_i is described as follows:

$$f(Y, B) = [F(X_i B)]^{Y_i} [1 - F(X_i B)]^{(1-Y_i)}, Y = 0, 1 \quad (8)$$

After applying the log likelihood logarithm, the development of the maximization of function with respect to β and after using the inverse of the Hessian matrix evaluated in $\hat{\beta}_{MV}$ the estimated probability for each woman is given by:

$$\hat{P}_i = \Phi(x'_i \hat{\beta}_{probit}) \quad (9)$$

2.2.2 Negative Binomial Law

The Frequency of ANC requires the use of methods such as Fish Law. However, given the over-dispersion⁴ (the variance exceeds the mean) of data in the intensity of ANC and therefore not respecting the characteristic of equidispersion (mean is equal to the variance) (Nanfosso and Kasiwa 2013), the negative binomial law is preferred. The distribution of ANC intensity is therefore given by the maximum likelihood to the negative binomial regression model as follows:

$$pr(y_i) = \frac{G(y_i + \psi_i)}{G(\psi_i)G(y_i + 1)} \left(\frac{\psi_i}{\lambda_i + \psi_i} \right)^{\psi_i} \left(\frac{\lambda_i}{\lambda_i + \psi_i} \right)^{y_i} \quad (10)$$

With $G(\cdot)$, the Gamma function and $\psi_i = (1/a)\lambda^k$ where $a > 0$ and k , a constant. Parameter a , allows to consider the over- or under-dispersion present in variable y . It is generally assumed to be constant and positive. If $a = 0$, the dispersion parameter disappears, and the distribution law becomes a Poisson's law. The two central trends are written as:

$$E(y) = \lambda \text{ and } var(y) = \lambda + a\lambda^{2-k} \quad (11)$$

With λ the expected number of ANC for a given woman during pregnancy, and ψ_i is a dispersion parameter.

2.3 Variables and data sources

2.3.1 Measurement of dependent variables

Antenatal Care Consultation (ANC): it is the care administrated to the women during the pregnancy but before the delivery. The data collected on the ANC concerns its important aspects. These data are obtained by asking women if, "during ANC, they had been informed of signs revealing complications of pregnancy, if certain medical examinations (blood pressure and urine and blood tests) had been carried out and also if they had been given medication (iron and medication against intestinal worms)" for the five (5) years preceding the survey. In reality, this indicator, due to the decision to use care for the first time, which is generally different from decisions for other times, as well as the recommendation of at least four (4) ANC according to the WHO, can be broken down into three, namely:

- **Incomplete ANC (Incomp ANC):** it measures participation in obstetric care services, i.e. the decision to use prenatal care services for the first time. It is defined as opposed to a complete ANC.
- **Complete ANC (Comp ANC):** This highlights the WHO recommendation that there should be at least four (4) ANC during pregnancy (WHO 2003). This indicator is often used in the empirical literature on maternal health.
- **Frequency of ANC:** The frequency of ANC provides an overall picture of women's decisions regarding the use of ANC during pregnancy. Thus, according to USAID, the frequency and depth of ANC evolve with the actual or potential problems detected during the previous ANC.

⁴ The over-dispersion is explained by the heterogeneity of mothers' health conditions which leads some women, knowing that they have often had complicated pregnancies, to make more prenatal consultations than those without complications.

Safe delivery: Safe delivery is defined as a delivery carried out either in a health facility or at home, assisted by a qualified person (Doctor, Nurse, Midwife, Matron, hospital, and health center worker). In the CDHS-MIC (2014-2015), women were asked about where their children were born, who attended the birth of these children and many other characteristics of childbirth.

Postnatal care: In the CDHS-MIC (2014-2015), women who had given birth in the two years prior to the survey were asked: "Did anyone monitor your health status while you were in the facility? ", "Did anyone check your health status after you left the facility? "Who checked your health status at that time? "For example, "How long after the birth did the first examination take place? "and "How many days after the birth did the first check-up take place? In this study, women who had their first check-up at all health facilities/physicians within 41 days of delivery are considered to have used postnatal care services.

2.3.2 Measurement of the independent variables

Three categories of explanatory variables classified into two types of factors are selected. These are the need variables (justifiable factors), non-need variables relating to the supply of care and non-need variables relating to the demand for care (unjustifiable factors).

Need Variables: The concept of care need in the context of maternal health care is definite like age, age at first birth, the complications of childbirth, management of abortion, obstetric fistula, and caesarean section. The age of the woman and the age at first birth are considered in this study. The age of the woman gives an idea of possible risks related to pregnancy. Indeed, age is the factor of degradation of health status, but this degradation in the context of obstetric health is interpreted as a risk associated with early and late motherhood (Mouté and Zinvi 2015). In the CDHS-MIC (2014-2015) database, the age of the woman is obtained from the answer to the questions "In which month and year were you born?" and "How old were you on your last birthday? ». On the other hand, age at first birth is obtained from the date the woman was born and the date she had her first birth.

Non-need variables related to the supply of care: these variables are measured by indicators such as distance of establishment, theoretical time, province of residence, residential environment. From this perspective, rural provinces are the provinces with the longest distance to health care facilities compared to urban provinces.

Non-need variables related to the demand of care: these variables are measured by indicators such as health and hygiene expenditure, the welfare quintile, women's participation in health decision-making, household size, women's education level, husband's education level, women's marital status, women's birth rank, sex of the head of household, marital status and women's religion.

2.3.3 Data sources

CDHS-MIC (2014-2015) provides to the study all dependent variables and few independent variables. ECOSIT3 (2011) provides the study with three variables, two of which are geographical and the other is economic. These are the distance to the nearest health service, the time taken to reach this service and finally the expenditure on health and hygiene. To introduce these variables into the analysis, it is assumed that these indicators do not vary between 2011 and 2014-2015. Indeed, the configuration of the Chadian health system has hardly changed, and the structure has

not changed as much in terms of volume. The provincial average of each of these variables was calculated before being associated with the CDHS-MIC data (2014-2015) for econometric estimates.

3 Results

3.1 Key Characteristics of Women and Uses of Obstetrical Care

Selected statistics for some characteristics of women aged 15-49 are provided here (Table 1). They show that the maternal mortality ratio (number of maternal deaths per 100,000 live births) represented for the seven (7) years preceding the survey is 860. This mortality rate reflects the proportions of women who died during pregnancy, during delivery, or in the two months following delivery, and represents 45% of all deaths among women aged 15-49 years (CDHS-MIC, 2014-2015). The literacy rate for this group of women appears to be quite low, at 15.89%. The proportion of women under 18 years of age is 3.33%, while that of women over 35 years of age is 14.48%. The proportion of women under 18 years of age who have their first birth is 53.26%; this proportion is only 0.05% for first births to the age beyond 35. This shows that first births are generally concentrated among young women and is confirmed by the average age at first birth of 17.86 years. The female population of childbearing age is predominantly rural. It accounts for 78.67% of the sample. Figure 1 shows the utilization of obstetric care. We find that 58.31% of women make at least one ANC, 28.11% make at least four ANC, 23.04% have a safe delivery, 19.94% receive postnatal care, and most (18.24%) have only three ANC in terms of frequency of ANC.

Table 1 Selected statistics on the situation of women of childbearing age in Chad

Sample Size	10,995
Maternal Mortality Ratio (MMR)	8.6 per 100,000 live births
Female literacy rate	15.89%
Proportion of women under 18 years of age	3.33%
Proportion of women over 35 years of age	14.48%
Proportion of women with first birth age below 18 years of age	53.26%
Proportion of women with first birth age over 35 years of age	0.05%
Average age of woman at first birth	17.86
Proportion of women living in rural/urban areas	78.67% /21.33%

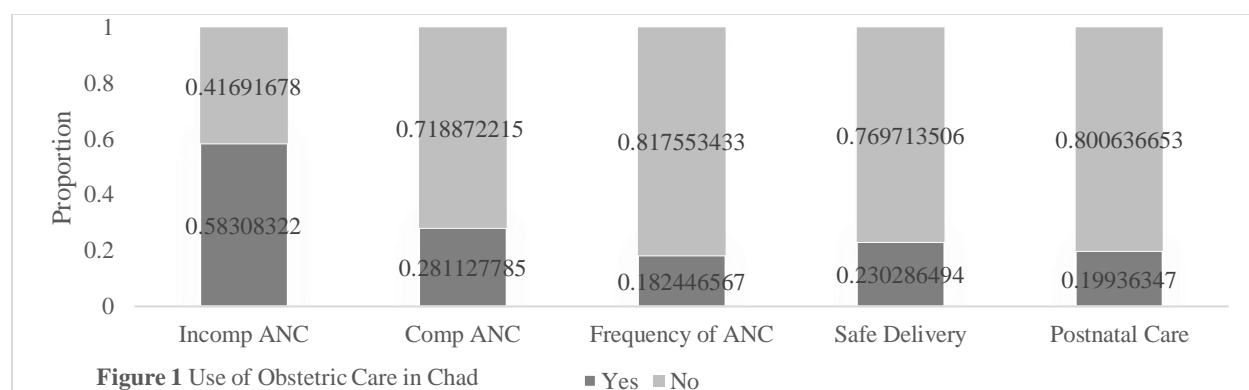


Figure 1: utilization of obstetric care

Note: The Yes specifies the proportion of women who accessed care and the No specifies the proportion of women who did not actually access care.

3.2 Obstetrical care utilization by woman characteristics

The use of all selected maternal health services shows higher proportions of urban women than rural women (Table 2). Only 22.67% of rural women have Complete ANC compared to 48.49% of urban women. These results highlight significant disparities by province of residence. For the six groupings of provinces included in the study, N'Djamena has a higher level of care utilization on all care indicators than the other provinces, followed by the southern provinces. However, the distribution of uses varies significantly among the other provinces.

Table 2 Proportion of effective access to obstetric care according to the characteristics of women of childbearing age in Chad

Obstetrical Care Utilization by Woman Characteristics	Incomp ANC	Comp ANC	Frequency ANC	Safe delivery	Postnatal care
Justifiable Factors (Need Variables)					
Age interval					
A15-17	59.78	26.45	15.91	25.62	20.94
A18-34	59.55	28.85	18.52	23.44	20.04
A35-49	54.16	26.02	17.43	21.39	19.47
P> z	0.000	0.017	0.006	0.049	0.728
Age at first birth					
AgeFBlessthan18	58.30	28.12	17.90	21.88	18.84
AgeFBgreatherthan18	58.32	28.11	18.63	24.35	21.18
P> z	0.989	0.991	0.986	0.002	0.002
Unjustifiable Factors (No-need Variables)					
Inequities related to supply factors (I)					
Housing environment					
Urban	78.95	48.49	20.62	57.16	40.47
Rural	52.79	22.67	17.61	13.92	14.45
P> z	0.000	0.000	0.000	0.000	0.000
Provinces of habitation					
North Provinces	35.70	17.63	10.37	19.11	14.96
Central Provinces	47.70	22.62	14.28	10.21	9.54
N'Djamena	83.15	58.50	(4 times) 20.61	75.77	50.00
West provinces without N'Djamena	39.06	18.58	11.01	9.20	9.61
East Provinces	47.94	17.46	16.01	15.86	14.26
Southern Provinces	77.52	37.03	26.45	30.25	27.82
P> z	0.000	0.000	0.000	0.000	0.000
Inequities related to demand factors (II)					
Wellness Quintile					
Quintile1	54.42	21.28	19.66	13.68	15.83
Quintile2	54.39	23.07	18.57	16.36	16.13
Quintile3	53.62	23.28	16.51	13.78	13.44
Quintile4	52.09	24.36	17.15	15.01	14.23
Quintile5	80.36	51.70	(4 times) 20.62	61.86	43.61
P> z	0.000	0.000	0.000	0.000	0.000
Person who decides on women's health					
WifealoneDH	66.42	30.84	24.47	28.59	24.22
Wife&HusbandDWH	60.89	27.40	21.71	24.98	21.26
HusbandaloneDWH	56.26	27.50	16.75	20.44	18.18
AnotherPDWH	59.68	27.42	(3&4 times) 16.13	32.26	25.81
P> z	0.000	0.247	0.000	0.000	0.000

Obstetrical Care Utilization by Woman Characteristics	Incomp ANC	Comp ANC	Frequency ANC	Safe Delivery	Postnatal Care
Women's level of education					
None	48.28	20.89	15.47	15.27	14.01
Primary	81.52	41.26	26.14	32.65	30.83
Secondary	88.36	56.18	24.53	62.16	42.24
Tertiary	94.55	78.18	(5 times)27.27	94.55	70.91
P> z	0.000	0.000	0.000	0.000	0.000
Level of education of the woman's husband					
None (husband)	45.19	19.38	14.31	13.01	12.20
Primary (husband)	75.11	35.06	25.52	30.39	27.98
Secondary (husband)	84.94	49.54	23.80	44.08	35.70
Tertiary (husband)	90.23	65.23	(4 times)23.44	72.66	57.81
Do not know (husband)	74.31	32.53	28.65	32.90	23.11
P> z	0.000	0.000	0.000	0.000	0.000
Gender of head of household					
Male Sex	58.87	28.10	18.67	23.01	19.91
Female Sex	55.37	28.20	16.03	23.19	20.07
P> z	0.006	0.931	0.005	0.864	0.880
Marital Status of Women					
Married	56.47	27.21	17.43	21.19	18.27
Living with a partner	75.26	34.85	26.94	31.33	31.77
NeverUSDW	65.74	33.12	20.53	38.04	29.72
P> z	0.000	0.000	0.000	0.000	0.000
Household size					
One to Five Members	56.80	27.25	17.43	22.02	18.96
Six and More	59.13	28.58	18.69	23.59	20.47
P> z	0.018	0.137	0.158	0.061	0.059
Birth Rank					
One to Three Children	60.65	30.34	18.11	26.12	21.89
Four to Six Children	56.20	25.89	18.41	20.45	17.70
Seven and More Children	57.38	27.51	18.23	21.55	19.82
P> z	0.000	0.000	0.003	0.000	0.000
Women's religion					
Christianity	80.24	39.41	27.18	33.98	30.45
Islam	47.44	22.67	13.69	18.20	15.13
Animist	51.85	14.81	25.93	11.11	11.11
No religion	62.26	27.99	21.07	11.95	13.21
P> z	0.000	0.000	0.000	0.000	0.000

Note: The values in the second, third, fifth and sixth columns are the proportions of Incomplete ANC, Complete ANC, Safe delivery, and Postnatal care, respectively. The figures in the fourth column represent the highest proportions of ANC. A15-17: aged 15-17 years; A18-34: aged 18-34 years; A35-49: aged 35-49 years; AgeFBlessthan18: age of first birth less than 18 years; AgeFBgreaterthan18: age of first birth greater than 18 years; WifealoneDH :Wife alone decides her health; Wife&HusbandDWH: Wife and Husband decide on women's health; HusbandaloneDWH: Husband alone decides on women's health; AnotherPDWH: another person decides on women's health;NeverUSDW: Never union, separate, divorced and widow bird.

Poorer women have roughly equal use of maternal health services than other women, but these uses are more prevalent among wealthier women. poorer groups, Poor, middle and rich groups have a respective use of Incomplete ANC of 54.42%; 54.39%; 53.62% and 52.09%, compared to 82.95% of the richest groups. Complete ANC (four ANC according to WHO), Safe delivery and Postnatal care have the same proportions. It is observed everywhere that there is no significant difference between the first four groups in the welfare quintile, but there is a gap between these groups and the richest group. The effect of women's empowerment appears to be mixed. Indeed, for the five care indicators, only the use of Incomplete ANC is represented by a significant

proportion of women who make decisions about their health alone, whereas for the other indicators, the effect is strongly influenced by other people.

The education of women and their husbands is linked to the use of maternal health services. Educated women have a higher proportion of utilization of maternal health services than women without formal education. It is evident that among highly educated women, 94.55% receive ANC at least once, 78.18% receive Complete ANC, most (27.27%) receive only 5 ANC, 94.55% receive Safe delivery and 70.91% receive postnatal care. The corresponding figures among illiterate women are 48.28%, 20.89%, 15.47%, 15.27% and 14.01%, respectively.

Among religious groups, Christian women have higher use of the five maternal health services than Muslim women, animists, and non-religious people. About 34% of Christian women give birth safely compared to 18.20% of Muslim women, 11.11% of women without religion and only 11.95% of Animist women. The woman's birth rank, the sex of the head of household and the woman's marital status have proportions of care use that vary according to different indicators of obstetric care.

A higher proportion of women aged 18 to 34 use ANC at least once, four times and only three times compared to their younger and older sisters. Household size is positively associated with use of maternal health services. It is 59.13% for women with six or more children compared to 56.80% for women with fewer than six children in terms of use of Incomplete ANC and presents the same proportions for the other indicators.

3.3 Decomposing inequalities in the uses of obstetric care

The results of inequalities in effective access to obstetrical care are given by the concentration curves (Figure 2), the inequality indices – proxied by the concentration index – and the contributing factors (Table 3) for the five (5) indicators considered. Columns 2, 5, 8, 11, 14, represent respectively the elasticities of Incomplete ANC, Complete ANC, Frequency of ANC, Safe delivery, and Postnatal care. Columns 3, 6, 9, 12, 15, represent the inequality indices for these same indicators. The fourth, seventh, tenth, thirteenth and sixteenth columns represent the contributing factors, i.e. the product of elasticities with concentration indices.

Table 3: Contributions of factors explaining inequalities in effective access to obstetric care in Chad

(1)	Incomp ANC			Comp ANC			Frequency of ANC			Safe Delivery			Postnatal Care		
	Elasti- cities (2)	C I (3)	Contri- butions (4)	Elasti- cities (5)	C I (6)	Contri- butions (7)	Elasti- cities (8)	C I (9)	Contri- butions (10)	Elasti- cities (11)	C I (12)	Contri- butions (13)	Elasti- cities (14)	C I (15)	Contri- butions (16)
Justifiable Factors (Need Variables)															
A15_17A35_49	-0.006	0.173	-0.001	-0.001	0.173	0.000	-0.005	0.173	-0.001	0.038	0.173	0.007	0.026	0.173	0.005
AgeFBlessthan18	0.012	0.082	0.001	0.026	0.082	0.002	0.009	0.082	0.001	-0.010	0.082	-0.001	0.003	0.082	0.000
Subtotal			0.000			0.002			0.000			0.006			0.005
Unjustifiable Factors (No-need Variables)															
Inequities related to supply factors (I)															
Distance	-0.361	0.004	-0.002	-0.258	0.004	-0.001	-0.423	0.004	-0.002	0.437	0.004	0.002	-0.007	0.004	0.000
Time	0.459	-0.006	-0.003	-0.039	-0.006	0.000	0.260	-0.006	-0.002	-0.450	-0.006	0.003	0.314	-0.006	-0.002
Rural	-0.217	-0.130	0.028	-0.238	-0.130	0.031	-0.198	-0.130	0.026	-0.617	-0.130	0.081	-0.508	-0.130	0.066
North Provinces	-0.003	0.439	-0.002	-0.002	0.439	-0.001	-0.003	0.439	-0.001	-0.007	0.439	-0.003	-0.003	0.439	-0.001
Central Provinces	-0.018	0.120	-0.002	-0.017	0.120	-0.002	-0.019	0.120	-0.002	-0.110	0.120	-0.013	-0.074	0.120	-0.009
N'Djamena	-0.023	0.934	-0.022	-0.004	0.934	-0.005	-0.012	0.934	-0.012	0.002	0.934	0.002	0.006	0.934	0.006
West without N'Djamena	-0.052	0.283	-0.015	-0.038	0.283	-0.011	-0.045	0.283	-0.013	-0.176	0.283	-0.050	-0.117	0.283	-0.033
East	-0.026	0.017	0.000	-0.041	0.017	-0.001	-0.032	0.017	-0.001	-0.076	0.017	-0.001	-0.047	0.017	-0.001
Subtotal (I)			-0.018			0.010			-0.007			0.021			0.026
Inequities related to demand factors (II)															
Health expenditure	0.224	0.090	0.020	-0.064	0.090	-0.006	0.074	0.090	0.007	-0.027	0.090	-0.002	-0.175	0.090	-0.016
Quintile1	-0.053	-0.800	0.043	-0.096	-0.800	0.077	-0.054	-0.800	0.043	-0.150	-0.800	0.121	-0.084	-0.800	0.067
Quintile2	-0.044	-0.381	0.017	-0.085	-0.381	0.033	-0.047	-0.381	0.018	-0.128	-0.381	0.049	-0.088	-0.381	0.034
Quintile3	-0.035	0.048	-0.002	-0.074	0.048	-0.004	-0.041	0.048	-0.002	-0.125	0.048	-0.006	-0.082	0.048	-0.004
Quintile4	-0.031	0.465	-0.015	-0.050	0.465	-0.024	-0.030	0.465	-0.014	-0.105	0.465	-0.049	-0.074	0.465	-0.035
Primary	0.060	0.098	0.008	0.064	0.098	0.009	0.051	0.098	0.007	0.040	0.098	0.008	0.061	0.098	0.010
Secondary	0.022	0.471	0.026	0.040	0.471	0.041	0.021	0.471	0.024	0.056	0.471	0.052	0.020	0.471	0.034
Tertiary	0.002	0.980	0.009	0.004	0.980	0.013	0.001	0.980	0.006	0.006	0.980	0.019	0.001	0.980	0.017
Do not know (husband)	0.009	0.109	0.001	0.007	0.109	0.001	0.009	0.109	0.001	0.024	0.109	0.003	-0.000	0.109	0.000

Table 3 Contributions of factors explaining inequalities in effective access to obstetric care in Chad, (Continued)

(1)	Incomp ANC			Comp ANC			Frequency of ANC			Safe Delivery			Postnatal Care		
	Elasti- cities (2)	CI (3)	Contri- butions (4)	Elasti- cities (5)	CI (6)	Contri- butions (7)	Elasti- cities (8)	CI (9)	Contri- butions (10)	Elasti- cities (11)	CI (12)	Contri- butions (13)	Elasti- cities (14)	CI (15)	Contri- butions (16)
Primary (husband)	0.036	0.047	0.002	0.045	0.047	0.002	0.042	0.047	0.002	0.081	0.047	0.004	0.082	0.047	0.004
Secondary (husband)	0.052	0.282	0.015	0.079	0.282	0.022	0.049	0.282	0.014	0.089	0.282	0.025	0.085	0.282	0.024
Tertiary (husband)	0.008	0.721	0.006	0.013	0.721	0.009	0.006	0.721	0.004	0.017	0.721	0.012	0.022	0.721	0.016
Female Sex	0.003	0.116	0.000	0.017	0.116	0.002	0.007	0.116	0.001	0.003	0.116	0.000	0.005	0.116	0.001
WifealoneDH	0.004	0.154	0.001	-0.003	0.154	-0.001	0.003	0.154	0.000	0.005	0.154	0.001	0.000	0.154	0.000
Wife&HusbandDWH	-0.001	0.140	0.000	-0.010	0.140	-0.001	-0.003	0.140	-0.001	0.021	0.140	0.003	0.002	0.140	0.000
AnotherPDWH	-0.000	0.103	0.000	-0.000	0.103	0.000	-0.000	0.103	0.000	0.003	0.103	0.000	-0.000	0.103	0.000
NeverUSDW	0.000	(omitted)	0.000	0.000	(omitted)	0.000	0.000	(omitted)	0.000	0.000	(omitted)	0.000	0.000	(omitted)	0.000
Married	-0.047	0.031	-0.001	0.087	0.031	0.003	0.030	0.031	0.001	0.033	0.031	0.001	-0.123	0.031	-0.004
One to Five Members	0.001	0.015	0.000	0.013	0.015	0.000	-0.000	0.015	0.000	-0.001	0.015	0.000	-0.024	0.015	0.000
Four to Six Children	0.003	0.115	0.000	0.011	0.115	0.001	0.000	0.115	0.000	0.006	0.115	0.001	-0.015	0.115	-0.002
Seven and more Children	0.006	0.177	0.001	0.023	0.177	0.004	0.014	0.177	0.003	-0.003	0.177	-0.001	0.007	0.177	0.001
Islam	-0.077	0.187	-0.014	-0.050	0.187	-0.010	-0.053	0.187	-0.010	0.103	0.187	0.020	-0.045	0.187	-0.008
Animist	-0.000	-0.250	0.000	-0.001	-0.250	0.000	-0.000	-0.250	0.000	-0.001	-0.250	0.000	0.000	-0.250	0.000
No Religion	-0.006	0.061	0.000	-0.006	0.061	0.000	-0.005	0.061	0.000	-0.021	0.061	-0.001	-0.018	0.061	-0.001
Subtotal (II)			0.093			0.140			0.085			0.217			0.094
Subtotal (I&II)			0.075			0.150			0.078			0.238			0.120
Residual : regression error			0.049			0.119			0.111			0.154			0.181
Residual : missing data			0.005			0.008			0.006			0.005			0.003
Inequality (total)			0.130			0.279			0.195			0.402			0.309
Inequity/Unjustified inequality			0.125			0.269			0.189			0.392			0.301

Note: The elasticities in columns 2, 5, 8 and 11 are obtained using weighted binary probit regression of the mean of the explanatory variables in the numerator and the mean of the explained variable in the denominator, respectively. On the other hand, the elasticities in column 10 are obtained using the negative binomial distribution weighted equally by the mean of the explanatory variables in the numerator and the mean of the explained variable in the denominator. The inequality indices are shown in columns 3, 6, 9, 12 and 15. The contributions to inequality shown in columns 4, 7, 10, 13 and 16 respectively are the products of the elasticities and inequality indices.

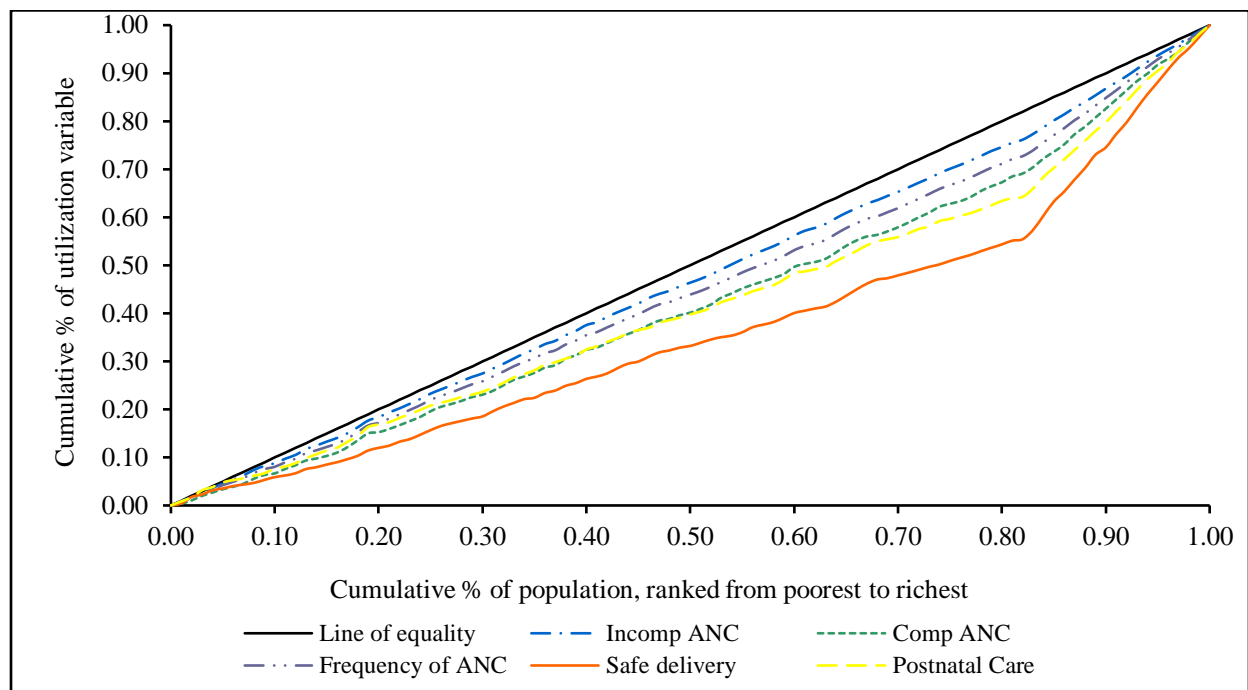


Figure 2 Concentration curve of obstetric care use by level of women's well-being

Note: Here the main diagonal (tie line) assumes perfect equality in the uses of obstetric care. The curves below the main diagonal reveal that there are inequalities to the disadvantage of the poor in effective access to Incomplete ANC (Incomp ANC), Complete ANC (Comp ANC), Frequency of ANC, Safe delivery, and Postnatal care.

The concentration curves show that care use is more concentrated among wealthy women. These inequalities are observed for the five maternity care service indicators selected for the study. However, the proportion of inequalities was found to be higher for access to Safe delivery, Postnatal care, and Complete ANC but relatively lower for the Frequency of ANC and Incomplete ANC.

Total inequalities in effective access to obstetric care are broken down into justifiable inequalities and inequities, but the shares of inequalities linked to missing observations are also observed (here 0.005; 0.008; 0.006; 0.005; 0.003 respectively for Incomplete ANC, Complete ANC, Frequency of ANC, Safe delivery and Postnatal care).

Looking at the contributions from the Incomplete ANC, it shows that overall inequalities in access to maternal health care are in favor of wealthy women. These inequalities are mainly explained by unjustifiable factors, i.e., inequity variables (0.125). Among the inequity factors, those provided by the variables not considered in the model are 0.049. On the other hand, the inequities generated by the variables considered in the model are 0.075. For these variables, the welfare quintile, housing environment and education level appear to be the main causes of inequities in the use of Incomplete ANC. For the welfare quintile (with a contribution of 0.043), it is the weight of poorer women (with a CI of -0.8009) compared to the least poor that explains the inequality in Incomplete ANC. The importance of the effect of the rural environment (with an elasticity of -0.2172 for a contribution of 0.028) in explaining inequality in Incomplete ANC is observed. The disparity in the secondary level is in favor of rich women (with a CI of 0.4718 for a contribution of 0.026) and

appears clearly in the explanation of inequality in Incomplete ANC for the level of education. All the main factors are in favor of wealthy women.

The contributions of the Complete ANC are explained at 0.269 by the inequity variables. Inequity variables not included in the model are 0.119, and those included in the model are 0.150. Like the inequities in Incomplete ANC, the inequities in the variables included in the Complete ANC are primarily driven by the welfare quintile, the woman's education level and her place of residence. Poor women are concentrated in the first welfare quintile and in rural areas with less sensitivity to the uses of obstetric care, while many rich women have a secondary level of education with high sensitivity to the uses of obstetric care. The importance of poor women in the first quintile relative to others (with a CI of -0.8009 for a contribution of 0.077) explains the difference in Complete ANC. The extent of wealthy women is represented by a CI of 0.4718 and an elasticity of 0.0402. The concentration index of poor rural women is -0.1304 and their elasticity is -0.2385. Compared to Incomplete ANC, it is observed that after the welfare quintile, the level of education appears in the second place in order of importance of inequality.

The contributions of Frequency of ANC come from the inequity variables for 0.189. The inequity variables not included in the model are 0.111 and those included in the model are 0.078. For the inequity variables included in the model, the welfare quintile, housing environment and education are always the main factors. The inequality in the distribution of the level of well-being shows that it is the poorest who use ANC less often (elasticity is -0.0541 and CI of -0.8009). The effect of housing environment indicates that the inequality in the Frequency of ANC is mainly due to living in rural areas rather than to the disparity between rural and urban women. Inequality among women at the secondary level explains the inequality in the Frequency of ANC (with a CI of -0.8009 and an elasticity of 0.0541).

Safe delivery has the following main factors: the welfare quintile (contribution of women in the first quintile of 0.121 with a CI of -0.8009 and an elasticity of -0.1508), the housing environment (contribution of rural women of 0.081 with an elasticity of -0.6119 and a CI of -0.1304), women's level of education (contribution of the secondary level of 0.052 for a CI of 0.4718 and an elasticity of 0.0566), the province of residence (contribution of the western region without N'Djamena of -0.050 for a CI of 0.2837 and an elasticity of -0.1765). The contributions of the inequity variables not considered in the model are 0.154 and those of the factors considered in the model are 0.238. Inequality contributions for care received after delivery are composed of contributions from justifiable factors (0.005) and contributions from unjustifiable factors (0.301). In the contributions of the unjustifiable factors, the inequities due to residuals are 0.181 and the inequities of the factors included in the model are 0.120. The main factors that explain the inequality in access to Postnatal care are the welfare quintile (contribution of women in the first quintile of 0.067 with a CI of -0.8009 and an elasticity of -0.0840), place of residence (rural contribution of 0.066 for an elasticity of -0.5082 and a CI of -0.1304) and educational attainment (secondary school contribution of 0.034 for a CI of 0.4718 and an elasticity of 0.0207).

Justifiable factors include the age of the woman and her age at first birth. With respect to the woman's age, more affluent women (CI of 0.1738) experience late and early childbearing and are less likely (elasticity of -0.0062) to have an Incomplete ANC. The same situations are observed for Complete ANC (with a CI of 0.1738 and an elasticity of -0.0017) and Frequency of ANC (with

a CI of 0.1738 and an elasticity of -0.0056). However, the disparity between women is rather positively correlated with Safe delivery (for an elasticity of 0.0383) and Postnatal care (for an elasticity of 0.0268). On the other hand, disparity between women about age at first birth is positively correlated with Complete, Incomplete ANC, Frequency of ANC and Postnatal care but negatively correlated with Safe delivery.

4 Conclusion and policy implications

The objective of this paper was to fill the research gap regarding literature on the determinants of inequality in effective access to obstetric care in Chad by applying the regression-based decomposition method of the inequality index as well as CDHS-MIC (2014-2015) and ECOSIT (2011) data. This decomposition method made it possible to analyze the sources of these inequalities by integrating explanatory variables into the model and to judge the inequitable nature of the distribution of obstetric care. The results showed that there are significant inequities in effective access to obstetric care associated with its determinants, and the main determinants are the welfare quintile, the place of residence and the level of education. These three main factors appear in the same order of influence for Incomplete ANC, Frequency of ANC, Safe delivery, and Postnatal care, except for Complete ANC, where the order of education and residence is reversed. Results also showed that inequalities in effective access to obstetric care in Chad are primarily linked to the problem of income gaps hence policies that aim at mitigating the effects of these gaps should be pursued. Secondly, these inequalities are also particularly explained by the problem of distance than by differences in the distribution of health services throughout the country. Finally, they are much more due to the problem of educational inequalities between rich and poor women than to the effects of education on these women. They have an important implication in terms of health policies in Chad. Indeed, with regard to the level of income, the leaders must in the short term reduce the income gaps of households or women of reproductive age, and for such a policy to be sustainable, it will be necessary to promote equality of opportunity in access to sources of income. It is recognized in the literature that poverty and poor health go hand in hand. In Chad, the Government had implemented two poverty reduction strategies (SNRP 1 and SNRP 2), some aspects of which are linked to improving the living conditions of the most vulnerable segments of the population. Under this heading, free health care was jointly implemented, but the mechanism remains little known to the target public. Moreover, such policies must be accompanied by the provision of information to enable everyone to access these services. In view of the economic crisis that Chad experienced in 2015, the ramifications of which have not completely disappeared, there are policy measures implemented to cushion women through the "targeted free care". However, those who benefit from it are not indigent women.

To mitigate the effects of distance, leaders need to subsidize transportation for women of childbearing age who live in rural areas, far from health facilities, and incur high transportation costs compared to their urban counterparts. Indeed, rural provinces are more distant from community care services and most specialized care than urban provinces. In Chad, the average distance to a health center in rural areas is 12 kilometers compared to 3 kilometers in urban areas (ECOSIT3, 2011). As part of the pursuit of the MDGs and then SDGs, Chad has put in place important measures aimed at considerably reducing this distance phenomenon. However, these measures prioritized the establishment and revitalization of health facilities. Such a policy remains advantageous but is not adapted to provide a short-term response by reaching the fringe of the rural population whose mobility constraint is very significant. In addition, given the geographic vastness

of the Chadian territory and its scattered population (Chad's 2019-2023 health map), the policy based on mobilizable transport resources will be more effective and optimal to implement. The State must therefore take additional and exceptional measures to encourage health personnel to go to rural areas where there is a lack of resources. For example, redeploy medical and paramedical staff to rural areas and other provinces that are in greater need, and make performance contracts to the ministries and directorates in charge of planning and transport.

To reduce educational inequalities, leaders need to increase the level of education among poor women and women of childbearing age. They must promote equal access to education between rich and poor women to ensure that this is sustained over time. Education is an object of uplifting the spirit and if investment in education is universal rather than limited to a few, the society will be more egalitarian. Education provides access to all other fundamental rights and remains an effective instrument for combating inequality, and to educate one woman is to educate a whole nation. In Chad, the literacy rate for women of childbearing age is 22% (44% for urban areas and 14% for rural areas), which implies that more effort needs to be made in this sector to promote education and reduce inequalities in access to care. The implementation of such an ambitious policy as that of evidence-based education needs a mechanism and a coherent but above all targeted implementation strategy.

Based on the findings of this study, we propose areas for future research. For instance, it would be interesting to examine women's treatment pathways in their health seeking behaviour. This will make it possible to see women's preference in effective access to obstetric care in Chad.

ACKNOWLEDGEMENTS

Acknowledgement information

The authors would like to thank the United States Agency International Development (USAID) and the National Institute of Statistics, Economic and Demographic Studies (INSEED) for the use of their databases. Also, the main author is very grateful to the United Nations Economic Commission for Africa (UNECA) for the use of their facilities during the completion of this paper as a Research Fellow with the Offices of the Executive Secretary (OES).

Funding information

The authors received no specific funding for this work.

Authors' information

Allara Ngaba Eric (PhD) is currently a Research Fellow with the Office of the Executive Secretary (OES), United Nations Economic Commission for Africa (UNECA), Addis Ababa, Ethiopia. He was previously a Research Assistant with the Applied Microeconomics Center. He is a Researcher and Lecturer of Economics at the University of N'Djamena, Tchad. His research interests are in the fields of Development Economics, Health Economics, Education Economics, and Labor Economics.

Fomba Kamga Benjamin (PhD) is Associate Professor with the Department of Economics, University of Yaoundé II. He is currently the Head of Department of Economics of the Faculty of Economics and Management, University of Yaoundé II, Cameroon. His research interests are in the fields of Labor Economics, Health Economics and Education Economics.

Disclaimers

The views expressed in this paper are those of the author and do not represent that of the United States Agency International Development (USAID), the National Institute of Statistics, Economic and Demographic Studies (INSEED) and the United Nations (UN).

Conflicts of interests

The authors wish to confirm that there are no known conflicts of interest associated with this publication.

5 References

- Ali, B. & Chauhan, S. (2020). Inequalities in the utilisation of maternal health Care in Rural India: Evidence from National Family Health Survey III & IV. *BMC Public Health*, 20, 369. <https://doi.org/10.1186/s12889-020-08480-4>
- De la Torre, A., Nikoloski, Z. & Mossialos, E. (2018). Equity of access to maternal health interventions in Brazil and Colombia: a retrospective study. *International Journal for Equity in Health*, 17 (1), 1-11. <https://doi.org/10.1186/s12939-018-0752-x>

- Fenny, A.P., Asuman, D., Crentsil, A.O. & Odame, D.N.A. (2019). Trends and causes of socioeconomic inequalities in maternal healthcare in Ghana, 2003–2014. *International Journal of Social Economics*, 46 (2) :288–308. <https://doi.org/10.1108/IJSE-03-2018-0148>
- Gwatkin, D.R., Bhuiya, A. & Vitoria, C.G. (2004). Making health systems more equitable. *Lancet*, 364 :1273–80. [https://doi.org/10.1016/S0140-6736\(04\)17145-6](https://doi.org/10.1016/S0140-6736(04)17145-6)
- Gyimah, S.O., Takyi, B.K. & Addai, I. (2006). Challenges to the reproductive-health needs of African women: on religion and maternal health utilization in Ghana. *Social Science & Medicine*, 62 (12): 2930–44. <https://doi.org/10.1016/j.socscimed.2005.11.034>
- Huda, M.T., Hayes, A. & Dibley, J.M. (2018). Examining horizontal inequity and social determinants of inequality in facility delivery services in three South Asian countries. *Journal of Global Health*, 8 (1). www.jogh.org • doi: 10.7189/jogh.08.010416
- Joshi, C., Torvaldsen, S., Hodgson, R. & Hayen, A. (2014). Factors associated with the use and quality of antenatal care in Nepal: a population-based study using the demographic and health survey data. *BMC pregnancy and childbirth*, 14:94. <https://doi.org/10.1186/1471-2393-14-94>
- Lerman, R. & Yitzhaki, S. (1989). Income Sources and Income Inequality: Measurement from Three US Income Surveys. *Journal of Economic and Social Measurement*, 15 (2), 167-179. <https://DOI:10.3233/JEM-1989-15204>
- Magadi, M.A., Agwanda, A.O. & Obare, F.O. (2007). A comparative analysis of the use of maternal health services between teenagers and older mothers in subSaharan Africa: evidence from demographic and health surveys (DHS). *Social Science & Medicine*, 64 (6), 1311–25. <https://doi.org/10.1016/j.socscimed.2006.11.004>
- Mohanty, S.K. & Pathak, P.K. (2009). Rich-poor gap in utilization of reproductive and child health services in India, 1992–2005. *Journal of Biosocial Science* 41 (3), 381–398. <https://doi.org/10.1017/S002193200800309X>
- Mouté, C. & Zinvi, F. (2015). Disparité générationnelle de l'évolution de la mortalité maternelle : effet de composition ou de comportement ? Institut de Formation et de recherche Démographiques (IFORD), *Document de travail*. <https://uaps2015.princeton.edu/papers/150962>
- Mutangadura, G., Gauci, A., Armah, B., Woldemariam, E., Ayalew, D. & Egu, B. (2009). Inégalités dans l'accès aux services de santé pour une sélection de pays d'Afrique : Situation et conséquences pour la politique Publique. *Actes de la Conférence*, Commission Economique des Nations Unies pour l'Afrique, Addis Abeba. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Knowledge/Conference_2007_21-part-V-1.pdf
- Nadjiroum, A.N. (2007). Pauvreté et accès aux soins obstétricaux au Tchad. Mémoire de Master, Institut de formation et de recherche démographiques (IFORD), Université de Yaoundé II, Cameroun.

- Nanfosso, R.T., Kasiwa, J.M. (2013). Les déterminants de la demande des soins prénataux en République Démocratique du Congo : Approche par données de comptage. *African Evaluation Journal*, 1 (1), 9. <https://doi.org/10.4102/aej.v1i1.26>
- Nwosu, C.O. & Ataguba, J.E. (2019). Socioeconomic inequalities in maternal health service utilisation: a case of antenatal care in Nigeria using a decomposition approach. *BMC Public Health*, 19, 94. <https://doi.org/10.1186/s12889-019-7840-8>
- Pallikadavath, S., Foss, M. & Stones, R.W. (2004). Antenatal care: provision and inequality in rural North India. *Social Science & Medicine*, 59 (6), 1147–58. <https://doi.org/10.1016/j.socscimed.2003.11.045>
- Presty, R.K., Gouda, J. & Pradhan, M.R. (2015). Inequality in the utilization of Maternal Health care Services in Odisha, India. *International Journal of Population Research*, vol. 2015, Article ID 531485, 10 pages, 2015. <https://doi.org/10.1155/2015/531485>
- Say, L. & Raine, R. (2007). A systematic review of inequalities in the use of maternal health care in developing countries: examining the scale of the problem and the importance of context. *Bulletin of the World Health Organization* 85 (10), 812–819. <http://dx.doi.org/10.2471/BLT.06.035659>
- Tchicaya, A. & Lorentz, N. (2011). Inégalité sociale dans le renoncement aux soins de santé et dans leur utilisation. Luxembourg Institute of Socio-Economic Research, *Working Papers n°2011-19*, 56 p. <https://www.liser.lu/?type=module&id=104&tmp=2784>
- Van Doorslaer, E., Masseria, C., & OECD HEALTH EQUITY RESEARCH GROUP MEMBERS. (2004). Income-related inequality in the use of medical care in 21 OECD countries. Organisation for Economic Co-operation and Development. *OECD HEALTH WORKING PAPER NO. 14*. <https://www.oecd.org/els/health-systems/31743034.pdf>
- Wagstaff, A., Van Doorslaer, E. & Watanabe, N. (2003). On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam. *Journal of Econometrics*, 112 (1), 207-223. DOI: 10.1016/S0304-4076(02)00161-6
- World Health Organization. (2003). Antenatal care in Developing countries: promises, achievements and missed opportunities. An analysis of trends, levels, and differentials, 1990-2001. Report for WHO and UNICEF. <https://www.unicef.org/media/files/antenatal.pdf>