

Quality of antenatal care and associated factors among pregnant women in East Africa using Demographic and Health Surveys: A multilevel analysis

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Abstract

Introduction: Antenatal care offers a forum for critical healthcare functions, including health education, screening, and disease prevention. Several pocket studies carried out in specific localities of East African countries were investigated. However, these were neither representative of the country nor specific to the recommended minimum of four antenatal care visits. Therefore, this study aimed to identify factors associated with quality of antenatal care among pregnant women in East Africa.

Methods: A secondary data analysis was done using Demographic and Health Survey data of six East African Countries from 2008 to 2018. A total of 46,656 women who gave birth in the 5 years preceding the survey were included in this study. A multilevel mixed-effect logistic regression model was fitted. Variables with a p-value < 0.05 were declared as significant factors associated with the quality of antenatal care.

Results: The magnitude of quality of antenatal care in East Africa was 11.16% (95% confidence interval: 10.87–11.45). Women of age 35–49 (adjusted odds ratio = 1.51; 95% confidence interval: 1.25–1.80), primary education (adjusted odds ratio = 1.35; 95% confidence interval: 1.18–1.55), richest wealth index (adjusted odds ratio = 2.35; 95% confidence interval: 2.02–2.74), and rural resident (adjusted odds ratio = 0.62; 95% confidence interval: 0.55–0.69) were among factors significantly associated with quality of antenatal care.

Conclusion: The magnitude of antenatal care quality was low in East Africa. Age, level of education, wealth index, birth order, husband/partners' level of education, residence, and living countries were among the factors associated with the quality of antenatal care. It would be useful to increase financial support strategies that enable mothers from poor households to use health services and enhance women's understanding of the significance of antenatal care utilization through health education targeting both women and partners with no education is very crucial.

Keywords

antenatal care, DHS, East African countries, multilevel mixed effects, quality

Date received: 15 November 2021; revised: 7 January 2022; accepted: 11 January 2022

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Introduction

Pregnancy is a vital time to prepare women and their families mentally and emotionally for good health and parenthood. Antenatal care (ANC) can be described as care given to pregnant women and teenage girls by professional health care providers to ensure the best health outcomes for both mothers and babies during pregnancy. ANC offers a forum for receiving health education, screening and diagnosis, and disease prevention. It has been proven that ANC can save lives. ANC also offers the ability for women, families, and communities to connect with and support them at a crucial time.^{1,2} The main purpose of focused ANC is to help women sustain normal pregnancies through early identification of pre-existing conditions, complications that arise during childbirth, and promotion of well-being.³ Moreover, one of the main strategies to improve maternal outcomes is ANC. ANC programs provide for early detection of risks and complications associated with pregnancy and ensure access to care, including health education, vaccines, medical testing, and therapies.⁴

With 546 maternal deaths per 10,000 live births, Sub-Saharan Africa has the world's highest regional maternal mortality ratio. The risk of maternal mortality peaks around the time of birth, when treatment coverage is at its lowest. A successful continuum of professional maternal care ensures that mothers receive critical health packages, minimizing the risk of maternal death from pre-pregnancy to childbirth and postnatal care.^{1,5} A change in the burden of maternal deaths from Asia to Sub-Saharan Africa is associated with differential patterns in fertility, the HIV/AIDS epidemic, and access to reproductive health services.⁶ Moreover, a quarter of infant deaths are accounted for by newborn deaths in the first 28 days of life, and the regional neonatal mortality rate (NMR) has not decreased over the last two decades at the same rate as under-5 mortality.⁶

According to World Health Organization (WHO), "Quality of care is the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with evidence-based professional knowledge."⁷ However, despite the increasing coverage of ANC in developing nations, maternal and neonatal death is still high.⁸ This shows that though the coverage of ANC is increasing, the undesirable health outcomes are still prominent.

In addition, several studies carried out in different areas of East African countries investigated factors influencing the use of ANCs, but these factors were neither representative of the country nor specific to the recommended minimum of four ANC visits.^{9,10} The only person and household features associated with the use of ANC facilities were included in the studies literature. However, indicated that context may affect the outcomes of individual health.¹¹ Therefore, this study aimed to estimate the overall

magnitude and factors associated with the quality of ANC in the six East Africa Countries from 2008 to 2018 data of Demographic and Health Survey (DHS).

Methods

Study setting and design

The United Nations (UN) Statistics Division has subdivided the African continent into five regions. Among these regions, East African countries make the largest region that includes 19 countries (Burundi, Comoros, Djibouti, Ethiopia, Eritrea, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Reunion, Rwanda, Seychelles, Somalia, Somaliland, Tanzania, Uganda, Zambia, and Zimbabwe). This study was a secondary data analysis based on DHS. Of these 19 East African countries, 6 countries (Djibouti, Somalia, Somaliland, Seychelles and Mauritius, Reunion) have no DHS data on their history and Eritrea has no recent data. In addition, six countries (Zambia, Zimbabwe, Tanzania, Uganda, Burundi, and Malawi) have not all the six components of ANC services for the most recent birth during ANC which is developed by WHO on their recent DHS data. So, the final analysis was conducted from the data of six countries including Ethiopia, Kenya, Comoros, Madagascar, Mozambique, and Rwanda. During the measure DHS survey, a community-based cross-sectional study design was used.

Data source, extraction and sampling strategy

The data of these six East Africa countries were accessed from the DHS program official database (www.measuredhs.com) after authorization was granted through an online request by explaining the goal of our study. We used the individual Record (IR file) data set and extracted the dependent and independent variables. To collect knowledge that is comparable across countries in the world, the DHS program adopts standardized methods involving uniform questionnaires, manuals, and field procedures. DHS is a nationally representative household survey that offers data from a wide variety of population, health, and nutrition tracking and effect assessment measures with face-to-face interviews of women aged 15–49. Stratified, multi-stage, random sampling is used in the surveys. Detailed survey techniques and methods of sampling used to collect data have been recorded elsewhere.¹²

Population and eligibility criteria

The source population for this study was all pregnant women aged 15–49 who had the most recent live birth in East Africa. All pregnant women aged 15–49 in East Africa who were in the selected countries were the study population. Specific pregnant women who have not all the six components of ANC services for the most recent birth

were excluded from the study. Accordingly, a total of 46,656 pregnant women who received ANC at least once during their most recent pregnancy and who have all the six components of ANC services were included in this study.

Operational definition

Quality of ANC: receipt of all essential components of ANC services such as blood pressure measurement, blood test, urine test, informed on possible complications, counseling on nutrition, and advice on birth preparedness plan during pregnancy.^{13,14}

Measurements

The outcome variable of this study was the Quality of ANC. The outcome variable is binary and it is coded as 1 if they had received all six essential ANC components and 0 otherwise. The construction of outcome variables was guided by the WHO antenatal care guidelines.^{15,16} We created an overall measure to ascertain if the women received all the six essential components of ANC. These components were blood pressure measurement, blood test, urine test, informed on possible complications during pregnancy, counseling on the nutrition received, and advice on a birth preparedness plan. Each question has a binary response (1=Yes; and 0=No). Explanatory variables included were age, place of residence, women's level of education, literacy, wealth index, birth order, country, husband education level, number of ANC visits, and ANC provider.

Data processing and analysis

Data processing and analysis were performed using STATA 15 software. The data were weighted using sampling weight, primary sampling unit, and strata before any statistical analysis to restore the representativeness of the survey and to tell the STATA to consider the sampling design when calculating standard errors to get reliable statistical estimates. Cross tabulations and summary statistics were conducted to describe the study population.

Since the DHS data has a hierarchical nature, women within a cluster maybe like each other more than women in the other cluster. Due to this, the assumption of independence of observations and equal variance across clusters might be violated. Therefore, an advanced statistical model is required to consider the between cluster variability to get a reliable standard error and unbiased estimate.

Furthermore, by considering the dichotomous nature of the outcome variable, multilevel mixed-effect logistic regression was fitted. Model comparison was done based on Akaike information criteria (AIC) and Bayesian information criteria (BIC). A mixed-effect model with the lowest information criteria (AIC and BIC) was selected.

The individual- and community-level variables associated with the Quality of ANC were checked independently in the bi-variable multilevel mixed-effect logistic regression model and variables that were statistically significant at p-value 0.20 in the bi-variable multilevel mixed-effects logistic regression analysis were considered for the final individual- and community-level model adjustments. In the multivariable multilevel mixed-effect analysis, variables with a p-value ≤ 0.05 were declared as significant determinants of the quality of ANC service. Intraclass correlation coefficient (ICC) was used to check whether the multilevel model is appropriate and how much of the overall variation in the response is explained by clustering.

Four models were fitted. The first was the null model that did not include exposure variables which were used to verify community variance and provide evidence to assess random effects at the community level. Then model I was the multivariable model adjustment for individual-level variables and model II was adjusted for community-level factors. In model III, the outcome variable was equipped with potential candidate variables from both individual- and community-level variables.

The fixed effects (a measure of association) were used to estimate the association between the quality of ANC service and explanatory variables and expressed as an odds ratio with a 95% confidence interval. Regarding the measures of variation (random effects), community-level variance with standard deviation and intra-cluster correlation coefficient (ICC) was used.

Results

Socio-demographic and economic characteristics

A total of 46,656 women who gave birth in the 5 years preceding each country's DHS survey were included in this study. The mean age of the women was found to be 28.95 ± 7.06 years with 95% confidence interval (CI) of (28.88–29.01). The majority 32,396 (69.44%) of the women lie in the age group of 20–34. Most of the women included were from Kenya 14,429 (30.93%) and the smallest number of women included from Comoros 2060 (4.42%). Three-fourth of the women were from rural residents 35,110 (75.25%) and 50.65% of the women had primary education (Table 1).

Maternal characteristics and magnitude of quality of ANC in six East African countries

The magnitude of quality of ANC in selected East African Countries was 11.16% (95% CI: 10.87–11.45) with the highest quality of ANC in Rwanda (18.43%) and the lowest quality of ANC in Ethiopia (5.55%). The majority 22,680 (48.61%) of the women included had at least four

Table 1. Socio-demographic and economic characteristics among ANC attendants in the six East African countries from 2008 to 2018 DHS data.

Variable	Weighted frequency	Percentage (%)	Weighted % of quality ANC
Age			
15–19	3374	7.23	8.5
20–34	32,396	69.44	11.8
35–49	10,886	23.33	10.08
Place of residence			
Urban	11,546	24.75	19.61
Rural	35,110	75.25	8.39
Women level education			
No education	12,761	27.35	4.99
Primary	23,630	50.65	10.59
Secondary	8210	17.6	18.3
Higher	2055	4.41	27.62
Literacy			
Cannot read at all	181,645	38.93	6.14
Able to read-only parts of a sentence	4694	10.06	8.89
Able to read the whole sentence	23,652	50.7	15.5
No card with required language	83	0.18	6.52
Blind/visually impaired	62	0.13	4.41
Wealth index			
Poorest	10,234	21.94	5.81
Poorer	9641	20.66	7.28
Middle	9137	19.58	9.19
Richer	8883	19.04	12.12
Richest	8761	18.78	2.76
Country			
Ethiopia	7590	16.27	5.55
Kenya	14,429	30.93	12.8
Comoros	2060	4.42	14.52
Madagascar	8644	18.53	6.77
Mozambique	7874	16.88	11.91
Rwanda	6059	12.99	18.43
Partner's education			
No education	9020	19.33	5.94
Primary	17,847	38.25	11.22
Secondary	6748	14.46	21.16
Higher	1923	4.12	37.32
Don't know	11,118	23.83	4.7

ANC: antenatal care; DHS: Demographic and Health Survey.

ANC visits and 29,130 (62.44%) of the women received their ANC from nurse (Table 2).

Factors associated with quality of ANC in East African countries from 2008 to 2018

In the random effects, the results of the null model revealed that there was statistically significant variability in the odds of quality of ANC with community variance 1.69 and the ICC in the null model suggested that 33.96% of the total variability in the quality of ANC was ascribed to the differences between communities. In the full model (model

adjusted for both individual- and community-level factors), community variance=0.98; standard error (SE)=0.05, which remained significant but reduced and 23.08% of the total variance of quality of ANC can be ascribed to the community (Table 3).

In the fixed effects, the model with smaller AIC and BIC best fit the data and the interpretation of the fixed effects was based on this model. Model III was adjusted for both individual- and community-level factors, and this model fits the data well. In the multivariable analysis, respondent's age group, place of residence, women's education, wealth index, birth order, husband/partner's

Table 2. Maternal characteristics and magnitude of quality of ANC among ANC attendants in the six East African countries from 2008 to 2018 DHS data.

Variable	Weighted frequency	Percentage (%)	Weighted % of quality ANC
Quality of ANC			
No	41,449	88.84	
Yes	5208	11.16	100
Birth order			
I	10,608	22.74	15.07
2–4	22,560	48.35	11.92
≥5	13,488	28.91	6.82
Number of ANC visit			
No visit	5576	11.95	0.77
One to three visits	18,401	39.44	8.75
At least four visits	22,680	48.61	15.67
ANC Provider			
Doctor	8030	17.21	14.78
Nurse	29,130	62.44	12.74
TBA ^a	583	1.25	2.28
Others ^a	8913	19.1	3.32

ANC: antenatal care; DHS: Demographic and Health Survey; TBAs: traditional birth attendants.

^aInclude midwife, health officer, and so on.

education, number of ANC visits, and living country were significantly associated with the quality of ANC in East Africa at 5% level of significance.

The odds of quality of ANC were 1.29 and 1.51 times higher among the women in the age group of 20–34 (adjusted odds ratio (AOR)=1.28; 95% CI: 1.11–1.50) and 35–49 (AOR=1.51; 95% CI: 1.25–1.80), respectively, as compared to the women in the age group of 15–19. Richest women were 2.35 times more likely to have the quality of ANC than women who are poorest (AOR=2.35; 95% CI: 2.02–2.74). The odds of quality of ANC are reduced by 38% among women living in rural residences (AOR=0.62; 95% CI: 0.55–0.69) as compared to women residing in urban areas. Women whose partners had a higher education are 2.27 times (AOR=2.27; 95% CI: 1.89–2.70) more likely to have the quality of ANC as compared to the women whose partners had no education. Pregnant women living in the following East African Countries are more likely to have quality of ANC, Kenya (AOR=2.14; 95% CI: 1.82–2.53), Comoros (AOR=1.61; 95% CI: 1.27–2.05), Mozambique (AOR=1.53; 95% CI: 1.28–1.83), Rwanda (AOR=3.03; 95% CI: 2.52–3.66), than women living in Ethiopia (Table 3).

Discussion

In this study, the overall magnitude of quality of ANC in selected Eastern African countries was 11.6%. Maternal age, birth order, wealth status, maternal and husband's educational status, residence, and the country in which the women live were significantly associated with the quality of ANC.

The results of this study revealed that the quality of ANC was higher among the women in the age group of 20–34, compared to the younger women in the age group of 15–19. These findings are aligned with the result from Kenya and Nigeria.^{17,18} This might be because older mothers may have a better understanding of the importance of utilizing the service. In addition, the older mother might get an opportunity of repeated health education and counseling in the preceding pregnancy that might enhance their knowledge about the benefits of ANC.

This study also revealed that the women who were classified under the richest wealth index had the quality of ANC than the poorest women. This finding was in line with the finding from Nepal¹⁹ and Kenya.¹⁷ This might be due to the high probability of attending the highest ANC follow-up by the richest women. In addition, this might be due to the person-centered services provided by healthcare providers at the governmental or non-governmental organizations (NGOs) that can increase the quality of ANC for women from the richest family.

In addition, the study showed that women who had a higher level of education had quality ANC. This result was in line with the study conducted in Tanzania²⁰ and Southern Ethiopia.²¹ This might be because an educated person can understand health care providers' instructions, education, and counseling due to better communication skills that facilitate interactions with health workers. In addition, they can easily obtain information from radio and televisions, printed materials prepared for enhancing awareness of pregnant women about the importance of ANC, and adherence to follow-up schedules.^{22,23}

Table 3. Factors associated with quality of ANC among attendants in six East African countries from 2008 to 2018 using multivariable multilevel mixed-effect logistic regression analysis.

Variables	Models			
	Null model AOR (95% CI)	Model I AOR (95% CI)	Model II AOR (95% CI)	Model III AOR (95% CI)
Age				
15–19				
20–34		1.43 (1.23, 1.67)		1.29 (1.11, 1.50)*
35–49		1.70 (1.42, 2.04)		1.51 (1.25, 1.80)*
Level of education				
No education				
Primary		1.45 (1.26, 1.66)		1.35 (1.18, 1.55)*
Secondary		1.71 (1.44, 2.02)		1.68 (1.42, 1.99)*
Higher		2.20 (1.78, 2.73)		2.03 (1.64, 2.51)*
Wealth index				
Poorest				
Poorer		1.29 (1.14, 1.47)		1.31 (1.15, 1.49)*
Middle		1.39 (1.22, 1.58)		1.41 (1.24, 1.61)*
Richer		1.65 (1.44, 1.88)		1.62 (1.42, 1.85)*
Richest		2.57 (2.23, 2.95)		2.35 (2.02, 2.74)*
Birth order				
1				
2–4		0.69 (0.64, 0.76)		0.69 (0.64, 0.76)*
≥5		0.49 (0.44, 0.56)		0.52 (0.46, 0.59)*
Partner's level of education				
No education				
Primary		1.40 (1.24, 1.58)		1.29 (1.14, 1.46)*
Secondary		1.83 (1.59, 2.10)		1.74 (1.51, 1.99)*
Higher		2.45 (2.05, 2.92)		2.27 (1.89, 2.70)*
Don't know		0.32 (0.27, 0.37)		0.26 (0.23, 0.31)*
Literacy				
Cannot read at all				
Able to read-only parts		1.03 (0.89, 1.21)		1.02 (0.87, 1.19)
Able to read the whole		1.34 (0.99, 1.52)		1.18 (0.99, 1.34)
No card		0.37 (0.15, 1.01)		0.42 (0.17, 1.02)
Blind/visually impaired		0.68 (0.19, 2.42)		0.59 (0.17, 2.14)
Place of residence				
Urban				
Rural		0.29 (0.27, 0.33)		0.62 (0.55, 0.69)*
Country				
Ethiopia				
Kenya		1.36 (1.16, 1.59)		2.14 (1.82, 2.53)*
Comoros		1.81 (1.42, 2.31)		1.61 (1.27, 2.05)*
Madagascar		0.86 (0.71, 1.04)		0.69 (0.57, 0.83)*
Mozambique		1.45 (1.21, 1.74)		1.53 (1.28, 1.83)*
Rwanda		3.55 (2.96, 4.27)		3.03 (2.52, 3.66)*
Random effects				
Community variance	1.69 (0.08)	1.17 (0.06)	1.16 (0.06)	0.98 (0.05)
ICC%	33.96%	26.24%	26.08%	23.08%
Model comparison				
AIC	29,960.07	27,438.60	29,207.22	27,031.56
BIC	29,977.55	27,622.18	29,277.15	27,267.60

ANC: antenatal care; AOR: adjusted odds ratio; CI: confidence interval; ICC: intraclass correlation coefficient; AIC: Akaike information criteria; BIC: Bayesian information criteria.

Bold implies the smallest AIC and BIC.

*Significant at p-value < 0.05.

Moreover, the current study revealed that the odds of quality of ANC were reduced by 38% among women living in rural residences. This finding agreed with a report from Nigeria and Ghana.^{13,18} This can be due to the proximity of the women who live in urban to health facilities since the facilities should be situated in the Urban. In addition, women who live in the urban can easily access important information about ANC from different sources such as NGOs, governmental, and private health facilities. Moreover, women in rural places are less educated and less independent than women in urban areas to try to find the quality of health care.²⁴

According to this study, ANC quality was reduced by 48% among women who had at least five children as reported consistently by studies in Ethiopia,²⁵ Haiti,²⁶ Nigeria,²⁷ and Brussels Metropolitan region.²⁸ This result could be due to less desire of women with multiple parities to attend whole ANC recommended visits. This might be due to having experience of giving birth during the last pregnancies and the belief that they do not need services as they have experience with pregnancy and childbirth.

The study also showed that women whose partners had higher education had the quality of ANC. This finding agreed with the report from Nepal¹⁹ that women whose husbands had higher education had increased ANC quality. This can be since educated husbands might be supportive and involved in the decision-making in the women's ANC utilization and also women who have educated partners were more likely to get optimal information on the ANC utilization.

Furthermore, the pregnant women living in Rwanda had the quality of ANC when compared with others. This can be due to differences in the health service coverage, particularly ANC coverage varies across the country. In addition, it may be due to variation of health workers' performance motivational factors like salaries, benefits, working environment with limited opportunities for supervision, mentoring and feedback and disproportional of the volume of clients with staff numbers which leads to staff burnout.^{15,29,30}

Conclusion

The quality of ANC was low in the six East African countries. The influences of several covariates on the quality of ANC were identified. Maternal age, educational level, wealth index, birth order, husband/partners' educational level, residence, and living countries were major factors associated with the quality of ANC.

Recommendations

It would be useful to increase financial support strategies that enable mothers from poor households to use health

services will be advantageous. To increase women's understanding of the significance of ANC utilization, health education targeting mothers with no education and husbands/partners with no education is very crucial. In addition, improving health workers' performance through supervision and mentoring will be advantageous to minimize the variation of ANC quality among mothers from different residences.

Strength and limitations of the study

The strength of this study was using the DHS data from different nations with large sample sizes which are nationally representative for each nation. Hence, this study makes valuable contributions to existing research on ANC quality in East Africa and it is among the few studies to examine the experience of quality of ANC in a low-resource setting, thus extending the evidence base for calls to improve the quality of ANC. Measuring the dimensions of quality of care with several items enabled us to identify key areas that need to be addressed to improve the quality of care. Despite the aforementioned strength, this study had some limitations: we used the most recent live birth in the past 5 years before the survey for calculation of quality of ANC; there might be a recall bias since we put only six essential components of services due, primarily, to data availability.

Acknowledgements

We, authors, acknowledge the Demographic and Health Surveys (DHS) Program funded by the U.S. Agency for International Development (USAID) for the accusation of the dataset.

Author contribution(s)

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Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval and consent to participate


Ethical clearance for the current study was obtained from the international review board (IRB) of the Demographic and Health Surveys (DHS) Program. Data are available to the general public by request in different formats from the Measure DHS website (www.measuredhsprogram.com). We applied the measure DHS by briefly stating the objectives of the study and got permission to download the dataset in STATA format. A permission letter for access to the database was received from the Measure DHS program. The DHS research protocol complies with the Helsinki declaration.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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Data availability and materials

The EDHS data sets are open and can be accessed from the Measure DHS website (www.measuredhs.com) through an online request by explaining the objective of the study. The datasets analyzed during the current study are available from the corresponding author upon reasonable request.

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