

# Factors Associated with Women's Timing of first Antenatal Care visit during their last pregnancy: Evidence from 2016 Uganda Demographic Health Survey.

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## Research Article

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# Abstract

**Background:** Utilization of antenatal care services (ANC) during pregnancy has been recognized as a major public health intervention to abate maternal morbidity and mortality. Uganda has experienced high levels of maternal morbidity and mortality over the past two decades. This could be partly attributed to the lower proportion of women who initiated their first antenatal care visit during the first trimester of their gestation period. This study aimed at investigating the factors associated with timing of first ANC visit by women in Uganda.

**Method:** This study used secondary data from the 2016 Uganda Demographic and Health Survey (UDHS). The study population comprises of women aged 15-49 who reported to have given their last birth during the five years preceding the 2016 UDHS survey. The outcome variable for this study was the timing of first ANC visit. Univariate, bivariate, and multilevel binary logistic regression analysis was used to determine the factors associated with the utilization of timing of first ANC visit.

**Results:** Findings show that only 30.3% of women utilized ANC during the first trimester. Women with secondary or higher education, women who were affiliated to Islamic religion, who reside in rural areas, and large family size were less likely to utilize ANC during the first trimester. Meanwhile women who formerly married were more likely to utilize ANC during the first trimester. Women who resided in communities with high socioeconomic status, and high media saturation were more likely to utilize ANC during the first trimester. Women who reside in communities with good access to health facility were more likely to utilize ANC during the first trimester as compared to women residing in communities inaccessible to health facility.

**Conclusion:** This study demonstrated that contextual factors are important predictors of utilization of ANC during the first trimester apart from individual, factors. It is thus important for maternal health programme interventions to consider both individual and contextual factors when encouraging women to utilize ANC services during the first trimester.

## Introduction

The timely utilization of antenatal care services is considered as one of the most important strategy for reducing maternal and infant morbidity and mortality [1, 2]. In 2003, Uganda adopted the focused antenatal care framework [3] for reducing the high maternal mortality in the country. The framework prescribed that a pregnant woman must use antenatal care services at least four times, of which the first visit must occur during the first trimester [4]. The 2016 Uganda Demographic and Health Survey shows that 97% of women received at least one antenatal care from a skilled health personnel [5]. However, maternal morbidity and mortality remained high with little progress regarding abating maternal deaths over the past two decades [5–7].

Globally, maternal mortality has reduced by 38% [8]. Despite such an improvement, it is reported that in 2017 approximately 295,000 women died from preventable causes related to pregnancy and childbirth

[8]. Over 94% of these deaths occurred in low and middle income countries, with the majority of them occurring among adolescents as compared to older women [8, 9]. It has been argued that, the high maternal mortality ratios in developing countries including sub-Saharan Africa were strongly correlated to low antenatal care service utilization [10].

Studies in the developing countries show that women initiate first antenatal visit very late after the first trimester, against the WHO recommendation. [11–13]. This is also evident in sub-Saharan Africa where a low proportion (38.0%) of women utilized antenatal care services during the first trimester.

Several studies have examined the association between the individual socioeconomic and demographic characteristics and timing of antenatal service utilization [11, 14–19]. However, these studies downplay the importance of community level factors in influencing early utilization of antenatal care services[20]. These studies have concluded the important role played by individual and community factors in influencing timing of the first antenatal care visit. However, their findings varied mainly due to variation in socioeconomic context [21–26]. Nonetheless, studies on community level influence on timing of antenatal care service utilization in Uganda are limited. Therefore, the purpose of this study is to investigate the individual and contextual factors associated with timing of first antenatal care visit among women in Uganda.

## **Methods**

### **Study Sample**

This study used secondary dataset from Uganda Demographic and Health Survey (UDHS) conducted in 2016. The study population comprises of 10045 women aged 15–49 who had their last birth in the five years preceding the survey and who responded to the question on when they initiated their first visit to antenatal care. [5]

## **Variables And Definition**

### **Outcome Variable**

The outcome variable for this study is the timing of the first visit to the antenatal care service. Women were categorized into two groups; the first group being women whose first visit to the antenatal care was within 12 weeks of their gestation period (first trimester), and the second group being women whose first visit to the antenatal care service was any time after 12 weeks (second trimester or later).

### **Individual Level Variables**

Individual level variables include women's level of education, employment status, place of residence, religion, parity, maternal age, marital status, household headship, family size, and wealth index. Maternal age at last birth was categorized as 15–19, 20–24, 25–29, 30–34, 35+ years. Education is defined as the

highest level of education attained by the mother and categorized as: no education, primary, secondary, and above. Employment was defined as woman who reported to have worked during the past 12 months preceding the survey and was categorized as: unemployed and employed. Place of residence was defined as type of dwelling where the woman resided categorized as rural and urban. Religion is defined as the religious affiliation of the woman and was categorized as Anglican, Catholic, Muslim, and other religious groups. Parity is defined as the number of children a woman has ever given birth to and categorized as 1, 2–3, 4 + children. Marital status is defined as legally marital state categorized as single, married, living together, and previously married (separated divorced and widowed). Sex of the household head refers to male or female recognized as household head of the unit by members of the household or him/herself. Wealth index was a measure of the household socioeconomic status and was categorized in this study as poor (combined poor and poorest quantile), middle, and rich (combined rich and richest quantile). Family size is defined as the number of household members in the household and was categorized as < = 4, 5–6 and 7 + members.

## Community Level Variables

There were four community-level variables in this study, and these include community mean distance to health facility, community socioeconomic disadvantages, community ethnicity diversity, and community media saturation. The community mean distance to health facility referred to the average distance of households to the nearest health facility in the Enumeration Areas (EAs). A woman was considered accessible if she resides in a household that falls within 5km radius of the nearest health facility [23] otherwise she is inaccessible to the nearest health facility. The distance to health facility was measured using ArcGIS software on 685 EA whose coordinates were found to be valid to nearest health facility [23]. The community socioeconomic disadvantage measured the proportion of women who were socioeconomically disadvantaged. The variable was constructed based on the household wealth index variable and defined as the proportion of women from poor and poorest households in the EA [27]. A woman was considered disadvantaged if she was from a poor and poorest household otherwise, she was considered advantaged. The community ethnicity diversity index is defined as the number of different ethnic groups and their proportional representation in the EA. The score ranges from 0 to approximately 1, the larger the index, the greater the diversity in an EA. For easy interpretation, the score is multiplied by 100; if an EA population belongs to one ethnic group, then an EA has the diversity index of 0. An EA diversity increases to 100 if the population is evenly divided into ethnic groups [28–30]. Community media saturation is defined as the proportion of women exposed to mass media information (radio, newspaper, television). The community media saturation is measured by the proportion of women who had been exposed to at least one media. Those who have access to any form of media were regarded to be high, and those who had no access to any form of media were regarded to be low saturation. Therefore, this variable ranged from 0–3 which is categorized into dichotomous: 0 representing 0 low saturation and 1–3 recoded: 1 representing high saturation [22]. All the community level variables were constructed and aggregated to Enumerated Areas (EA).

# Statistical Methods

The descriptive statistics was used to summarize key variables in the univariate data and were presented in percentages. At the bivariate level, frequencies and cross-tabulations were used to verify the distribution of outcome variable by choosing the individual and community level characteristics. The chi-square test was used to examine statistical association between timing of first antenatal care and covariates. The 2016 UDHS data is hierarchical in nature and therefore multilevel binary logistic regression modelling is thus appropriate to test the association between individual and contextual variables and timing of first use of antenatal case service. The multilevel regression equation of the model is as follows:

$$\log \left[ \frac{\pi_{ij}}{1 - \pi_{ij}} \right] = \beta_0 + \beta_1 x_{1ij} + \beta_2 x_{2ij} + \dots + \beta_n x_{nij} + u_{0j} + e_{ij}$$

Where  $\pi_{ij}$  is the probability of  $j^{\text{th}}$  individual in  $i^{\text{th}}$  community utilizing ANC in the first trimester.  $(1 - \pi_{ij})$  is the probability of  $j^{\text{th}}$  individual in  $i^{\text{th}}$  community not utilizing ANC in the first trimester,  $\beta_0$  is the log odds of the intercept,  $\beta_1, \dots, \beta_n$  are the effect sizes of individual and community-level factors,  $X_{1ij}, \dots, X_{nij}$  are independent variables of individual-level and community-level,  $u_{0j}$  the quantities of random errors at cluster levels.

Four multilevel binary logistic regression models are employed to test the association between individual and contextual variables and timing of first use of antenatal case service. In the first model, which is empty (Model 0), no covariate was introduced. The model is used to test the random effect of between-EAs variability. The inter-class correlation coefficient (ICC) was estimated to establish if it is justified to use multilevel analysis method by showing the level of variation between-EAs. The second model (Model 1) determined the effects of individual-level characteristics on women's timing of first antenatal care visit. The ICC was calculated and observed if there is any change in between-EA variability upon adding the individual-level characteristics to the empty model. The third model (Model 2) introduced community-level characteristics and excluded the individual level characteristics. In the fourth model (Model 3), which is the combined model, both the individual-level and community-level characteristics were fitted to show their net fixed and random effects. The random effect was explained using the inter-Class Correlation (ICC) using the following formula  $[ICC = \sigma_u^2 / (\sigma_u^2 + \pi^2 / 3)]$ . The Proportional Variance Change (PVC) was computed for each model with respect to the empty model to show the variability on the odds of timing of first use of ANC, which is explained by the successive models. The PVC is calculated using the following formula:  $PVC = (V_e - V_m) / V_e$  where  $V_e$  is a variance in the empty model and  $V_m$  is the variance in the successive models [31]. The fixed-effect sizes of individual-level and community-level factors on timing of first ANC visit was stated using the Odd Ratio (OR) and community effect sizes were estimated using 0.5% Confidence Interval (95% CI) [32, 33].

## Results

# Univariate Analysis

Table 1 shows the percentage distribution of women who had their last birth during the five years preceding the survey and had utilized ANC services by their background characteristics. A total of 10045 women reported to have utilized ANC during their last pregnancy preceding the 2016 UDHS. Only 30.3% of these women had their first ANC visit during their first trimester. Over half (53.0%) were aged between 20 to 29 years, and 13.7% were adolescents. Their mean age was 28 years. The proportion of women married and living together was 82.3%. Majority of households where women resided were headed by males (73.1%). The average parity among women and average number of household members were four children per woman and six people per household correspondingly. Over half (61.2%) of the women had primary school education with slightly over a quarter (26.4%) having secondary education or higher. Majority of the women resided in rural areas (79.9%), belonged to either the Anglican or Catholic denomination (72%) and were employed (79.9%). Over half (54.0%) of the women belonged to the rich wealth index bracket. Over half (63.4%) of the women resided in communities that were inaccessible to the health facility. Nearly three-quarters (73%) of women belong to communities that were socioeconomically disadvantaged. Slightly above three quarters of the women (78.3%) belonged to a less diverse community. A higher proportion (73.4%) of women belonged to communities which are not media saturated (**See** Table 1).

Table 1  
 Percentage distribution of women who had their last birth 5 years prior  
 the 2016 UDHS and who utilized ANC services by background  
 characteristic

<b>Characteristics</b>	<b>All Women N = 10045</b>	<b>Percentage</b>
<b>OUTCOME VARIABLE</b>		
<b>Timing of ANC</b>		
First trimester	3044	30.3
Second trimester	7001	69.7
<b>INDIVIDUAL VARIABLES</b>		
<b>Age at last birth</b>		
<=19	1376	13.7
20–29	5323	53.0
30–39	2822	28.1
40+	524	5.2
<b>Marital Status</b>		
Single	557	5.5
Married	4168	41.5
Living together	4095	40.8
Previous married	1226	12.2
<b>Household Head</b>		
Male	7339	73.1
Female	2706	26.9
<b>Parity</b>		
1	1958	19.5
2–3	3351	33.4
4+	4736	47.1
<b>Family Size</b>		
<=4	3358	33.4
5–6	3068	30.5

<b>Characteristics</b>	<b>All Women N = 10045</b>	<b>Percentage</b>
7+	3619	36.0
<b>Level of Education</b>		
No education	1238	12.3
Primary	6156	61.3
Secondary or Higher	2651	26.4
<b>Place of Residence</b>		
Urban	2010	20.0
Rural	8035	80.0
<b>Wealth Index</b>		
Poor	4628	46.1
Middle	1915	19.1
Rich	3502	34.8
<b>Religion</b>		
Anglican	3112	31.0
Catholic	4117	41.0
Muslim	1263	12.5
Other's	1553	15.5
<b>Employment Status</b>		
Unemployed	2024	20.1
Employed	8021	79.9
<b>COMMUNITY VARIABLES</b>		
<b>Community Distance to Health Facility</b>		
Inaccessible	6280	62.5
Accessible	3680	36.5
<b>Community Socioeconomic Status</b>		
Disadvantaged	6543	65.1
Advantaged	3502	34.9

<b>Characteristics</b>	<b>All Women N = 10045</b>	<b>Percentage</b>
<b>Community Ethnicity Diversity Index</b>		
Less Diverse	5864	58.4
More Diverse	4181	41.6
<b>Community Media Saturation</b>		
Less Saturated	7356	73.2
Saturated	2689	26.8

## **Bivariate Analysis**

Table 2 shows the percentage distribution of women who had their last birth 5 years prior the 2016 UDHS and utilized ANC services by timing of ANC and background characteristic. Close to about a third of the women who utilized ANC services (30.3%) did so during the first trimester. The proportion of women who first utilized ANC services during the first trimester differed significantly by woman's age at birth of last child, marital status, sex of head of household, woman's parity, household size, education, religion, community's access to the nearest health facility and community's media saturation.

Table 2

Percentage distribution of women who had their last birth 5 years prior the 2016 UDHS and utilized ANC services by timing of ANC and background characteristic

<b>Variables</b>	<b>First trimester (%)</b>	<b>Second trimester (%)</b>	<b>All women N = 10045</b>	<b>P-Value</b>
<b>INDIVIDUAL VARIABLES</b>				
<b>Age at last birth</b>				0.001
<=19	28.3	71.7	1376	
20–29	31.9	68.1	5323	
30–39	29.1	70.9	2822	
40+	26.0	74.0	524	
<b>Marital Status</b>				0.014
Single	28.7	71.3	558	
Married	31.4	68.6	4175	
Living together	28.7	71.3	4102	
Previous married	32.5	67.5	1226	
<b>Household Head</b>				0.463
Male	30.1	69.9	7339	
Female	30.9	69.1	2706	
<b>Parity</b>				0.000
1	30.8	69.1	1958	
2–3	32.9	67.1	3351	
4+	28.2	71.8	4736	
<b>Family Size</b>				0.000
<=4	32.5	67.5	3358	
5–6	30.8	69.2	3068	
7+	27.9	72.1	3619	
<b>Level of Education</b>				0.000
No education	36.0	64.0	1238	
Primary	28.6	71.4	6156	

<b>Variables</b>	<b>First trimester (%)</b>	<b>Second trimester (%)</b>	<b>All women N = 10045</b>	<b>P-Value</b>
Secondary or Higher	31.6	68.4	2651	
<b>Place of Residence</b>				0.331
Urban	31.2	68.8	2010	
Rural	30.1	69.9	8035	
<b>Wealth Index</b>				0.105
Poor	30.1	69.9	4628	
Middle	28.7	71.3	1915	
Rich	31.4	68.6	3502	
<b>Religion</b>				0.002
Anglican	29.5	70.4	3112	
Catholic	32.2	67.8	4117	
Muslim	27.1	72.9	1263	
Other's	29.3	70.7	1553	
<b>Employment Status</b>				0.913
Unemployed	30.2	69.8	2024	
Employed	30.3	69.7	8021	
<b>COMMUNITY VARIABLES</b>				
<b>Community Distance to Health Facility</b>				0.030
Inaccessible	29.5	70.5	6280	
Accessible	31.6	68.4	3680	
<b>Community Socioeconomic Status</b>				0.077
Low	29.7	70.5	6543	
High	31.4	68.4	3502	
<b>Community Ethnicity Diversity Index</b>				0.791
Less Diverse	30.2	69.8	5864	
More Diverse	30.4	69.6	4181	
<b>Community Media Saturation</b>				0.004

Variables	First trimester (%)	Second trimester (%)	All women N = 10045	P-Value
Less Saturated	29.5	70.5	7356	
Saturated	32.5	67.5	2689	
<b>Total</b>	<b>30.3</b>	<b>69.7</b>	<b>10045</b>	

Nearly a third (31.9%) of women aged 20 to 29 years old had their first ANC visit during their first trimester as compared to women aged less than 19 years old (28.3%), women aged 30 to 39 years (29.1%) and those aged 40 years and above (26%). A third (32.5%) of the women were previously married utilized ANC services during the first trimester compared to those married (31.4%), and those living together and single (28.7%) respectively. A lower proportion (28.2%) of women who had four or more children made their first ANC visit compared to their counterparts with 2 to 3 children (32.9%) and 1 child (30.8%). Slightly above a quarter (27.9%) of women who belong to households with seven or more members first utilized ANC services during their first trimester as compared to about a third (32.5%) and 30.8% who resided in households with fours or less members and 5 to 6 members respectively. Over third (36%) of women with no education utilized ANC services during the first trimester as compared to those with a primary and secondary or higher level of education (28.6% and 31.6% respectively). Only 27.1% of women affiliated to Muslim religion reported to have first utilized ANC services during the first trimester as compared to women affiliated to other religion (Anglican (29.5%), Catholic (32.2% and other religious groups 29.3%). The proportion of women who utilized ANC services in the first trimester was significantly higher (31.6%) for women residing in from communities that are averagely accessible to the nearest health facility as compared to their counterparts who resided in inaccessible communities (29.5%). A third of women (32.5%) who resided in communities with a higher media saturation utilized their first antenatal care service during the first trimester as compared to 29.5% of women who resided in communities with less media saturation (See Table 2).

## Multilevel Analysis

The multilevel logistic regression results for timing of first antenatal care service visit by women in Uganda are shown in Table 3 with four models. The first model (model 1) which is the empty model, investigated the intercept and random variance component. The findings show a variance coefficient was statistically significant ( $\tau = 0.331, p = 0.000$ ). In this model, the intra-community correlation coefficient was 9.14%. This indicates the presence of clustering of timing of first ANC service utilization during the first trimester between the Enumerated Areas (EA) due to unobserved individual and community level variables in Uganda. Model 2 included the individual level variables only.

Table 3

Multilevel Analysis showing the Odd Ratio's on the effect of Individual and Community level factors on timing of ANC utilization in Uganda, UDHS 2016

Variables	Model 1	Model 2	Model 3	Model 4
	Empty Model	Individual level	Community level	Individual/Community level
	Odd Ratio	Odd Ratio	Odd Ratio	Odd Ratio
	(95% CI)	(95% CI)	(95% CI)	(95% CI)
<b>INDIVIDUAL VARIABLES</b>				
<b>Age at last birth</b>				
<=19		1.00		1.00
20–29		1.17*(0.99–1.37)		1.17 (0.99–1.37)
30–39		1.12 (0.92–1.37)		1.12 (0.92–1.37)
40+		0.95 (0.72–1.26)		0.96 (0.72–1.26)
<b>Marital Status</b>				
Single		1.00		1.00
Married		1.16 (0.92–1.46)		1.12 (0.89–1.40)
Living together		0.99 (0.80–1.24)		0.99 (0.79–1.24)
Previous married		1.30*(1.02–1.65)		1.32*(1.04–1.68)
<b>Household Head</b>				
Male		1.00		1.00
Female		0.94 (0.84–1.05)		0.937 (0.84–1.05)
<b>Parity</b>				
1		1		1.00

**Note:** The Empty Model contain no variables, but it partitioned the variance into two component parts. AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, CI = Confidence Interval, PCV = Proportional Change in Variance,® Reference category, VPC = Variance Partitioned Coefficient, Significant level, \*\*\*p = < .001, \*\*p < .01, \*p < .05.

Variables	Model 1	Model 2	Model 3	Model 4
	Empty Model	Individual level	Community level	Individual/Community level
	Odd Ratio	Odd Ratio	Odd Ratio	Odd Ratio
	(95% CI)	(95% CI)	(95% CI)	(95% CI)
2-3		0.98 (0.84-1.13)		0.99 (0.86-1.15)
4+		0.82*(0.69-0.99)		0.85 (0.71-1.01)
<b>Family Size</b>				
<=4		1.00		1.00
5-6		0.96 (0.85-1.08)		0.95 (0.84-1.06)
7+		0.88*(0.78-0.99)		0.86*(0.76-0.97)
<b>Level of Education</b>				
No education		1.00		1.00
Primary		0.76***(0.65-0.88)		0.78**(0.67-0.90)
Secondary or Higher		0.78*(0.65-0.93)		0.99*(0.65-0.95)
<b>Place of Residence</b>				
Urban		1.00		1
Rural		1.07 (0.91-1.26)		0.62**(0.45-0.83)
<b>Wealth Index</b>				
Poor		1.00		1.00
Middle		1.05 (0.91-1.20)		1.07 (0.94-1.25)
Rich		1.09 (0.95-1.24)		1.09 (0.97-1.37)

**Note:** The Empty Model contain no variables, but it partitioned the variance into two component parts. AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, CI = Confidence Interval, PCV = Proportional Change in Variance,® Reference category, VPC = Variance Partitioned Coefficient, Significant level, \*\*\*p < .001, \*\*p < .01, \*p < .05.

Variables	Model 1	Model 2	Model 3	Model 4
	Empty Model	Individual level	Community level	Individual/Community level
	Odd Ratio	Odd Ratio	Odd Ratio	Odd Ratio
	(95% CI)	(95% CI)	(95% CI)	(95% CI)
<b>Religion</b>				
Anglican		1.00		1.00
Catholic		1.04 (0.93–1.16)		1.03 (0.92–1.15)
Muslim		0.84*(0.71–0.99)		0.84*(0.72–0.99)
Other's		0.97 (0.84–1.12)		0.97 (0.84–1.12)
<b>Employment Status</b>				
Unemployed		1.00		1.00
Employed		1.02 (0.92–1.26)		1.01(0.90–1.14)
<b>COMMUNITY VARIABLES</b>				
<b>Community Distance to Health Facility</b>				
Accessible			1.00	1
Inaccessible			0.70**(0.56–0.87)	0.36***(0.23–0.55)
<b>Community Socioeconomic Status</b>				
Low			1.00	1.00
High			1.19*(1.05–1.38)	1.18*(1.05–1.34)
<b>Community Ethnicity Diversity Index</b>				
Less Diverse			1.00	1.00
<p><b>Note:</b> The Empty Model contain no variables, but it partitioned the variance into two component parts. AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, CI = Confidence Interval, PCV = Proportional Change in Variance,® Reference category, VPC = Variance Partitioned Coefficient, Significant level, ***p = &lt; .001, **p &lt; .01, *p &lt; .05.</p>				

Variables	Model 1	Model 2	Model 3	Model 4
	Empty Model	Individual level	Community level	Individual/Community level
	Odd Ratio	Odd Ratio	Odd Ratio	Odd Ratio
	(95% CI)	(95% CI)	(95% CI)	(95% CI)
More Diverse			1.09 (0.85–1.39)	1.19 (0.85–1.38)
<b>Community Media Saturation</b>				
Less Saturated			1.00	1.00
Saturated			1.23*(1.05–1.34)	1.19*(1.05–1.34)
<b>Intercept</b>	-0.85 (0.43)***	-0.91 (0.41)***	-0.87 (0.41)***	-0.48 (0.62)***
<b>Random intercept variance</b>	<b>0.331</b>	<b>0.313</b>	<b>0.342</b>	<b>0.308</b>
<b>ICC(%)</b>	<b>9.14</b>	<b>8.69</b>	<b>9.42</b>	<b>8.56</b>
<b>PCV</b>	<b>Reference</b>	<b>6.36</b>	<b>1.82</b>	<b>9.09</b>
<b>AIC</b>	<b>44442.571</b>	<b>44674.363</b>	<b>44505.257</b>	<b>44730.028</b>
<b>BIC</b>	<b>44451.785</b>	<b>44681.575</b>	<b>44512.471</b>	<b>44737.240</b>
<b>Note: The Empty Model contain no variables, but it partitioned the variance into two component parts. AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, CI = Confidence Interval, PCV = Proportional Change in Variance,® Reference category, VPC = Variance Partitioned Coefficient, Significant level, ***p &lt; .001, **p &lt; .01, *p &lt; .05.</b>				

Individual level variables associated with timing of first antenatal care service utilization by women in Uganda in model 1 include age at last birth, marital status, parity, education, religion, and family size. Being aged 20 to 29 years increased odds of a woman visiting antenatal care services during the first trimester (Odds Ratio, 1.17, CI 0.99–1.37) when compared to women aged less than 20 years. Women who were formerly married were more likely to use ANC during the first trimester (Odds Ratios, 1.30, CI 1.02–1.65) compared to single women. Having four or more children decreased the odds of utilizing ANC services during the first trimester (Odds Ratio, 0.82, CI 0.69–0.99). Women who had primary and secondary or higher education were less likely to utilize antenatal care during the first trimester (Odds Ratio, 0.76, CI 0.65–0.88, and 0.78, CI 0.65–0.93 respectively) as compared to women with no education. Being affiliated to the Islamic religion reduced the odds of utilizing ANC services during the first trimester (Odd Ratio, 0.84, CI 0.71–0.99) when compared to those affiliated with the Anglican religion. Residing in a household with seven or more family members reduced the odds of utilizing antenatal care during the

first trimester (Odds Ratio, 0.88, CI 0.78–0.99) when compared to women residing in households with four or less members. The random intercept variance was ( $\tau = 0.313$ ,  $p = 0.000$ ) which gave a proportional reduction change of 6.36 from the empty model. The ICC reduced by 8.7%, meaning the clustering of timing in the first utilization of antenatal care services may be related to the composition of individual level characteristics.

Model 3 included the community level variables only results indicate that the community ethnicity diversity index variable was not associated with timing of antenatal care service utilization among women in Uganda. Timing of first ANC visit was significantly associated with the community's accessibility to the nearest health facility, community's socioeconomic status and community's media saturation. The odds of women utilizing antenatal care during the first trimester decreased significantly with community accessibility to nearest health facility (Odd Ratio, 0.70, CI 0.56–0.87). Women who resided in communities with high socioeconomic status were more likely to utilize ANC during the first trimester compared to women who resided in communities with low socioeconomic status (Odd Ratio, 1.19, CI 1.05–1.38). The model reveals that residing in communities with high media saturation increased the odds of utilizing ANC during the first trimester (Odd Ratio, 1.23, CI 1.05–1.34) compared to those residing in communities with low media saturation. The variance for the random intercept increased and was statistically significant ( $\tau = 0.342$ ,  $p = 0.000$ ). The ICC was increased to 9.4% compared to model 2. The percentage increase of ICC from model 3 indicates that the clustering of timing of first visit to ANC was also related to community level factors.

Model 4 introduced both the individual and community level variables. In this model, timing of first ANC utilization was association with marital status, level of education, religion, residence, and household family size. The odds of utilizing ANC services in the first trimester remained higher among formerly married (Odd Ratios, 1.32, CI 1.04–1.68) compared to the never married (single). The odds of utilizing ANC services in the first trimester decreased for women with some level of education. Women who had primary education or higher were less likely to attend ANC services during the first trimester when compared to women without any formal education (Odd Ratios, 0.78, CI 0.67-0.90 and 0.79, CI 0.65–0.95 respectively). Women who were affiliated to the Islamic religion were less likely to utilize ANC services during the first trimester (Odd Ratios, 0.84) compared to women affiliated to the Anglican religion. Women who resided in rural areas were less likely to attend ANC services during the first trimester (Odd Ratios, 0.62, CI 0.45–0.83) when compared to those in urban areas. Women who belong to households with seven or more members were less likely to utilize ANC during the first trimester compared to their counterpart residing in households with 4 or less family members (Odd Ratios, 0.86, CI 0.76–0.97). Further, women who lived in communities that were Inaccessible to the nearest health facility were almost three times less likely to attend ANC during the first trimester, compared to those who resided in accessible communities (Odd Ratios, 0.36, CI 0.23–0.55). Women who lived in communities with high socioeconomic status were more likely to utilize ANC in the first trimester, compared to their counterpart residing in communities with low socioeconomic status (Odd Ratios, 1.18, CI 1.05–1.34). Women who resided in media saturated communities were more likely to utilize ANC during the first trimester compared to women who reside in area with less media saturated communities (Odd Ratios, 1.19, CI

1.05–1.34). Comparatively the random intercept remained statistically significant in 1.02–1.65 the final model ( $\tau = 0.308$ ,  $p = 0.000$ ). The ICC decreased to 8.6% from that of ICC in model 3 showing that inclusion of both the individual and community level factors was important in explaining the timing of the first ANC visit by women. The overall model fit statistics AIC and BIC shows that community level characteristics increased the fit of the multilevel model in explaining the variations in the timing of first antenatal care services across community (See Table 3).

## Discussion

This study examined the factors associated with the utilization of timing of first ANC visit.

A significant majority of women in Uganda begin to utilize antenatal care services late. There is a low proportion of women who utilized antenatal care services during the first trimester. These findings were in line with evidence from other developing countries, especially in sub-Saharan Africa which indicate that a small proportion of women reported early to utilize antenatal care services [11, 12, 34–36]. This study revealed that both the individual characteristics and community context were important predictors of timing of first utilization of antenatal care services in Uganda.

Findings in this study indicate that individual level factors linked with use of antenatal care services during the first trimester included marital status, level of education, religious affiliation, place of residence and household family size. In Uganda, women who were formerly married were more likely to utilize ANC services in the first trimester compared to other marital status. Literature from studies conducted in Zambia and Tanzania show that women's marital status was a significant predictor of early use of ANC services [11, 14]. These could be attributed to the level of autonomy among women. Ugandan communities are mainly dominated by patriarchal structure where power in the household mainly are vested on men, hence this has a great effect on gender relations [15, 16].

Higher education among women is usually associated with greater level of awareness about the existence of health services. In addition, higher level of education also avails women with some level of autonomy. Above all, education provide women with greater opportunity to receive information about dangers associated with pregnancy [17, 37]. Unexpectedly, findings from this study were contrary to the traditional findings in the literature which indicate that women with secondary or higher education were more likely to utilize ANC services in the first trimester [38–41]. Findings from this study show that women with secondary or higher education were less likely to initiate their first visit to ANC service utilization in the first trimester compared to those with no education. These findings were in line with other studies in Pakistan and Nigeria which show that women with secondary or higher education were less likely to initiate their first ANC visit during the first trimester compared to those with no education [42, 43]. The reason why women with no education may be more likely to utilize ANC in the first trimester could be attributed to the information provided by community health workers regarding the importance of utilizing maternal healthcare services [44]. Besides, the reason why women with primary education and high may be unlikely to attend ANC in the first trimester could be due to perceived condition of pregnancy,

the user-unfriendly booking and overcrowded health facility, the long waiting time and some rude service providers [45, 46].

Findings from this study revealed that religious affiliation was a significant predictor of timing of first visit to antenatal care among women in Uganda. Women who were affiliated to Islamic religion were less likely to utilize ANC services during the first trimester compared to those affiliated to Anglican and Catholic religions respectively. A similar study in Uganda [47], also revealed that Muslim women were less likely to utilize antenatal care services at the first trimester compare to other religious denominations. Religion as a socio-cultural factor has varying influences among religious denominations. For instance, Muslim women observe certain religions and cultural practices during pregnancy which health personnel providing maternal health care services need to know and understand. A blanket policy approach to providing antenatal care services to women without regard to the religious affiliation may limit early access to maternal health care services and increase negative maternal and child health outcomes. For example, according to the Islamic religion; a woman's body may only be viewed only by her husband, but provision of antenatal care may involve skilled male health personnel which may contradict Muslim beliefs [19, 48, 49].

Timing of first visit to antenatal care service utilization in Uganda has varied according to place of residence. Women from rural areas were less likely to utilize antenatal care services in the first trimester as compared to those in the urban areas. These findings are in line with other studies conducted in Bangladesh [50–52]. Conversely, in Ethiopia a studies found that women in rural areas were more likely to utilize antenatal care services during the first trimester compared to those in urban areas [53, 54]. Although these could be the case in Ethiopia, such variation could be due to availability of information and health care services for women in rural areas [37, 55]. On the other hand, urban areas have long been associated with high socioeconomic status and access to improved social amenities which avails those residing in urban areas with access to higher quality services compared to those who reside in rural areas [56, 57].

Findings from this study show that women who reside in households with a large family size were less likely to initiate their first visit to antenatal care services during the first trimester compared to those residing with smaller families. These findings corroborate other studies in sub-Saharan Africa that shows that women who reside with large families were less likely to utilize ANC services during the first trimester compared women who reside in a household with a small family size [53, 58]. This may be attributed to pressures put on the limited resources by the family size. For example, literature has negatively associated large family size and income pressures. Women who come from large family sizes often suffer from financial deficiencies due to low income compared to women residing in households with a small family. In the context of Uganda, almost 85% of the population live in rural areas. So, accessing health facility has proven to be very difficult due to long distances which require travel expenses [53, 59, 60].

Community contextual factors associated with timing of antenatal care service utilization included the community mean distance to the nearest health facility, community socioeconomic status and community media saturation. In this study, the community mean distance to health facility was negatively associated with timing of first visit to antenatal care service utilization among women in Uganda. Women who reside in communities that were averagely inaccessible to health facility were less likely to initiate their first visit to antenatal care service utilization during the first trimester compared to those residing in communities considered accessible. Contrary to these findings, findings from studies in Zambia and Benin showed no association between timing of first visit to antenatal care service utilization and distance to health facility [61, 62]. Studies in sub-Saharan African opined distance as a factor in the utilization of health facilities [27, 49, 63, 64]. For instances, Gabrysch and Campbell [63] found distance to health facility having two effects; distance as disincentive to motivate people from seeking care, and an obstacle for reaching health facilities, and is mainly augmented by poor transport and lack of roads.

Findings show that women residing in communities with high socioeconomic status were more likely to initiate their first visit to antenatal care service utilization during the first trimester as compared to women residing in communities with low socioeconomic status. This finding may suggest economic accessibility [65]. These findings are contrary to other findings from multicounty analysis from sub-Saharan Africa which shows that women community-level poverty was not associated with timing of antenatal care service utilization. The lack of association of community-level poverty and timing of antenatal care service utilization in sub-Saharan Africa could be explained to other endogenic factors [25].

Further, women who belong to communities where media is highly saturated were more likely to initiate their first visit to antenatal care service utilization during the first trimester compared to women from low or no media saturation communities. Similarly, other studies from sub-Saharan Africa and South Asian countries have underscored media penetration as a major influencer in the utilization of antenatal care services [18, 54, 66, 67]. Mass Media is recognized globally to complement education in the process of creating awareness and information regarding maternal health care services[25]. Mass media is a major source of distributing information to increase health knowledge and changing the health behaviours of women in order to improve maternal health [68, 69].

## **Limitation And Strength Of The Study**

This study has its own limitations and the first is the use of Enumerated Areas (EAs) as a proxy for community. This has the potential to bias the results of the study due to population endogeneity and selection effect [26, 27]. The potential confounding bias were also possible mainly due to variables that were not measured and controlled for in this study [27]. There is a possibility of recall bias which may occur due to the retrospective nature of the study whose answers may not be verified due to the secondary nature of the data. The cross-sectional nature of the data restrict casual effect inference between the individual level independent variable and the dependent individual level of the variables [26]. Despite these limitations, the outcome variables values can be easily remembered as it relates to whether a woman utilized ANC during the first three months or later. This study contributed to a body of

knowledge by examining the effects of community level variables together with individual level variables, on the timing of antenatal care utilization. Such studies are relatively scarce in Uganda. One of the main strengths of this study is that this study measured distance to health facility was measured using ArcGIS software on 685 enumeration areas whose coordinates were found to be valid from each household to the nearest health facility [47]. This helped to eliminate distance bias created by determining accessibility by using perceived distance or perceived accessibility as a proxy. The study also adopted the Simpson diversity index [29] to measure the influence of ethnicity in the utilization of antenatal care which is relatively scarce in the context of Uganda. The study used women from enumerated areas as unit of analysis, such information can be generalized to the study population.

## **Conclusion**

This study managed to demonstrate the importance of community context and individual level factors influencing timing of ANC. The contextual factors associated with the timing of first ANC visit were community mean distance to health facility, community socioeconomic status and community media saturation. In Uganda, women residing in communities that were not accessible to the nearest health facility were less likely to utilize ANC services during their first trimester. Communities with high socioeconomic status and communities that had high media saturation were more likely to utilize ANC services during their first trimester. Individual level factors associated with the timing of first ANC included marital status, level of education, religion, residence, and family size. Policy interventions geared towards improving the quality of maternal and child health outcomes in health facilities should focus on both the individual and community characteristics.

## **Abbreviations**

ANC Antenatal Care, EA Enumerated Areas, ICC inter-class correlation, OR odd ratio PNC Postnatal Care, PVC Proportional Variance Change, UDHS Uganda Demographic and Health, WHO World Health Organization.

## **Declarations**

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

The authors' sought for written permission to download and use the data from MEASURE DHS/ICF International, Rockville, MD, USA. The DHS data before collection ethical clearance was sought from the respective countries research ethic boards.

### **Consent for publication**

Consent for publication is not applicable since the authors used secondary data which the consent was obtained from DHS MEASURE to use the data.

## Availability of data and materials

The dataset for this study was obtained with permission from DHS program repository at <https://dhsprogram.com/data/availabledatasets.cfm>

## Competing interest

The authors of this manuscript here do declare that there is no competing interest.

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## Authors' Contributions

Conceptualization of article: Moses Festo Towongo, Enock Ngome, Kannan Navaneetham, Letamo Gobopamang. Acquisition: Moses Festo Towongo. Data analysis: Moses Festo Towongo, Enock Ngome. Interpretations of the data: Moses Festo Towongo, Enock Ngome, Kannan Navaneetham. Software used: Moses Festo Towongo. Revision of the article draft: Moses Festo Towongo, Enock Ngome, Kannan Navaneetham, Letamo Gobopamang, approval of submission Moses Festo Towongo, Enock Ngome, Kannan Navaneetham, Letamo Gobopamang.

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