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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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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% [95%CI; 0.28–0.31] of women utilized ANC during the first trimester. Women of higher parity (4+) were less likely to utilize ANC in the first trimester compared to the lower parity (1) (AOR, 0.74, CI; 0.60–0.92). 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 (AOR, 1.36, CI; 1.04–1.77). Women who reside in less diverse ethnic communities were less likely to utilize ANC in the first trimester compared to their counterparts (AOR, 0.15, CI; 0.11–0.22).

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.

Keywords: Individual, Household, Community, Antenatal care visits, Uganda

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]. WHO in its previous focused ANC framework prescribed four ANC visits for every normal pregnancy [3],

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since 2016 the framework was updated from four to eight contacts, with the first contact to occur within three months (12 weeks) [4]. Early and adequate utilization of ANC from a skilled provider is associated with improved maternal health, reduced low birth weights, and lower neonatal mortality [5, 6]. Besides, timely utilization of ANC also act as a mediating factor for health facility delivery and utilization of postnatal care services [7].

In 2003, Uganda adopted the focused antenatal care framework [8] 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 [9]. However, of recent, the Ministry of Health in Uganda have updated its framework to suit the new WHO guidelines which prescribed a continuum of care for pregnant women to make eight contacts, deliver in health facility, and be attended by skilled health personnel [10, 11]. Further, the 2016 Uganda Demographic and Health Survey (UDHS) shows that 97% of women received at least one antenatal care from a skilled health personnel [12]. However, a lower proportion of these women utilized ANC services in the first trimester (30%), and maternal morbidity and mortality remained high in Uganda with little progress regarding abating maternal deaths over the past two decades [12–14].

Globally, maternal mortality has reduced by 38% [15]. Despite such an improvement, it is reported that in 2017 approximately 295,000 women died from preventable causes related to pregnancy and childbirth [15]. 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 [15, 16]. 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 [4].

Studies in the developing countries show that women initiate first antenatal visit very late after the first trimester, against the WHO recommendation [17–19]. 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 [17, 20–25]. However, these studies downplay the importance of community level factors in influencing early utilization of antenatal care services [26]. 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 [27–32]. Moreso, several studies have been conducted on the timing of ANC in Uganda and they established the role played by socioeconomic, demographic, and cultural factors in influencing timing of ANC [7, 33–37], and these studies mainly focused on individual level factors. Besides, these studies have been inconsistent in their findings regarding the factors that influence the timing of ANC at individual-level characteristics [7, 33, 38]. Studies on context are of great importance in that, contextual-level factors reveal the characteristics of community in which the women reside and these may influence their decision towards utilization of maternal health care services, independent of individual women characteristics [39]. Uganda has an ambitious target on her vision 2040 of reducing maternal deaths to 15 deaths per 100, 000 live birth [40], also the country is a signatory to global agenda of Sustainable Development Goals (SDGs) 3.1 of reducing maternal deaths to 70 deaths per 100,000 live births by 2030 [41]. Nonetheless, studies on community level influence on timing of antenatal care service utilization in Uganda are limited. Therefore, this study aims to investigate the individual and contextual factors associated with timing of first antenatal care visit among women in Uganda. This study adds to body of knowledge by adopted DHS revised methodology which accounted for complex data at multilevel modeling by applying weights both at individual and community-level. The findings from this study would present better evidence-based results to the policymakers and other stakeholders to design and implement solutions at different levels to increase early utilization of ANC services across health facilities 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 9443 weighted sample of 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 [12] .

Variables and definition

Outcome variable

The outcome variable for this study is the timing of the first visit to the antenatal care services. The outcome variable for this study was based on WHO focused antenatal care framework [3] and 2016 Ministry of Health clinical guidelines available during the time when the survey was conducted [42]. The timing for the first

antenatal care visit describes how many months of pregnancy a woman was during her first ANC visit. Timing was initially numeric ranging from 0 to 10 months and was categorized into two; first trimester (1), and not in the trimester (0) [33].

Independent varaiables

From the 2016 Uganda Demographic and Health Surveys (UDHS) data set the following individuals and contextual level factors was run with respect to timing of first ANC visit.

Individual-level women's characteristics

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 poorer 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.

Contextual-level characteristics

In this study, contextual or community is a sampled Enumeration Areas (EAs) (there were 696 EAs). An EA in Uganda covers an average of 130 households in each geographic area. The UDHS sampling frame for identifying Primary Sampling Units (PSUs) or EAs was based on most recent census enumeration areas created for the 2014 National Population and Housing Census (NPHS). An EA is a natural village in rural areas and a city block in urban areas [12]. There were four contextual--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-level variables were constructed by aggregating individual level characteristics at the community (EA) level.

Community mean distance to health facility

The community mean distance to health facility referred to the average distance of households to the nearest health facility in the Enumeration Areas (EAs). To generate distance variable, this study used ArcGIS Software version 10.6.1 to calculate the proximity from the Enumerated Areas (EAs) to nearest health facilities. The near function in the ArcGIS was used to locate the nearest health facility to the EA [43]. The geospatial dataset for EAs and health facility was obtained from Uganda Bureau of statistics (UBOS). The near distances from the health facilities to 685 EAs were calculated in meters and later converted into kilometres. According to World Health Organization (WHO) recommendation, a health facility must be located within an average distance of 5 km radius for easy accessibility. The values of distance generated from ArcGIS were later entered into Stata version 14.2. The distance was then recoded into dichotomous; individuals who reside within 5kms range radius were regarded to have access to health facility and those that were residing more 5 km range radius were otherwise considered to be inaccessible to health facility. Finally, the information obtained from individual variable were aggregated to EAs to form the community level variable. This variable is grouped into two outcomes, less than 5 km (accessible), and more than 5 km inaccessible.

Community socioeconomic disadvantage

The community socioeconomic disadvantage measured the proportion of women who were socioeconomically disadvantaged. The dummy variable for DHS household wealth index was constructed from household assets and developed using principle component analysis. The PCA scores are classified as poorest, poorer, middle, richer, and richest wealth quintiles [44]. This variable was recoded into groups, poorer and the poorest formed low socioeconomic group, and the middle, rich and the richest form the high socioeconomic group. The variables were aggregated to the PSU (Enumerated Areas). The computed community-level variable was dichotomized as low and high based on the proportional value computed after checking the distribution. Since the aggregated variable is not normally distributed, a median value was used as cut-off point of categorization. Community socioeconomic status was categorised to low if the proportion of

women was less than 50% and high if the proportion is above 50% [45].

Community ethnicity diversity index

The community ethnicity diversity index is defined as the number of different ethnic groups and their proportional representation in the EA. To generate the ethnicity diversity an index formula was adopted, that captures both the number of different groups in an Enumerated Area (EA) and the relative representation of each group [46].

$$\text{Ethnicity diversity index} = 1 - \sum_{i=1}^{n}\left[\frac{x_i}{y}\right]^2$$

Where:
x_i = population of ethnic group i of the EA,
y = total population of the EA, and.
n = number of ethnic groups in an 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 [39, 46, 47].

Community media saturation

Community media saturation is defined as the proportion of women exposed to mass media information (radio, newspaper, television) in the Enumerated Areas (EAs). The responses were recoded 1, if a woman was exposed to newspaper, radio, or television and 0 if the woman was not. To create the index of exposure to media, the three forms of media were summed up of all scores for each woman, the scores ranged from 0 to 3 and the final score were recoded and categorised into two groups. A value 0 meant no access, 1 to 3 recoded 1 meant had access. This individual-level variable was aggregated to community-level variable. The computed community-level variable was dichotomized as low and high based on the proportional value computed after checking the distribution. Since the aggregated variable is not normally distributed, a median value was used as cut-off point of categorization. Community media saturation was categorised to low if the proportion of women exposure to media was less than 50% and high if the proportion is above 50% [45].

Statistical methods

The data was analysed using Stata version 14.2 software. A bivariate analysis was performed between individual and community level characteristics and timing of first antenatal care service utilization. The chi-square test was used to examine statistical association between predictor and outcome variables. The cut-off point for level of significance was set at *p*-value less than 0.25 [45]. All variables which were found significant at bivariate model were subjected to multicollinearity test, and the test was conducted using variance inflation factor (VIF), the results shows that there is no presence of multilinearity among them (mean VIF = 1.25, Min VIF = 1.00, Max VIF = 1.95). Since the 2016 UDHS data is hierarchical in nature, therefore, multilevel binary logistic regression modelling was appropriate to test the association between individual and contextual variables and timing of first use of antenatal case service. The multilevel binary logistic regression equation of the model is stated as follows [48]:

$$\log\left[\frac{\pi_{ij}}{1-\pi_{ij}}\right]\beta_0 + \beta_1 x_{1ij} + \beta_1 x_{2ij} + \cdots + \beta_n x_{nij} + uoj + eij$$

Where π_{ij} is the probability of j^{th} individual woman in i^{th} community (EA) utilizing ANC in the first trimester. $(1\text{-}\pi_{ij})$ is the probability of j^{th} individual woman in i^{th} community (EA) not utilizing ANC in the first trimester, β_0 is the log odds of the intercept, β_1, … β_n are the effect sizes of individual and community-level factors, X_{1ij}... X_{nij} are independent variables of individual-level and community-level, u_{Oj} the quantities of random errors at cluster levels. e_{ij}..the random error at the individual level.

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, Null Model), 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 contains only individual-level variables) 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 contain only the contextual-level variables) introduced community-level characteristics and excluded the individual level characteristics. In the fourth model (Model 3 contains both the individual and contextual-level variables), which is the combined model, both the individual-level and community-level characteristics were fitted to show their net fixed and random effects. The fixed-effects measures the association between individual-level and community-level factors on timing of first ANC visit was stated using

the Odd Ratios (OR) with 95% confidence intervals, and *P*-values less than 5% [48, 49]. The random effect was explained using the inter-Class Correlation (I CC) using the following formula [ICC = σu^2 / ($\sigma u^2 + \pi^2$ /3)] [50]. The log likelihood ratio test was conducted to examine the adequacy of the model, and Akaike Information Criteria (AIC) was used to assess how well the different models fitted the data. To account for non-response among the sampled units in Uganda 2016 DHS data, we adopted the DHS methodology of approximating level-weights to normalize the data. The "svyset" module in the model was used to account for the complex sample by taking into consideration the three pieces of design elements; weights, EAs and the strata. Meanwhile at multivariate level, the approximated weights were applied to the model to normalize the samples for individual and community-levels (EA). This method helped to prevent the problem of inflated type one error and large confidence intervals [51].

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 9433 weighted sample of women reported to have utilized ANC during their last pregnancy preceding the 2016 UDHS. Only 29.7% (CI 0.28–0.31) of these women had their first ANC visit during their first trimester. Over half (53.6%) were aged between 20 to 29 years, and 13.7% were adolescents. The proportion of women married and living together was 81.5%. 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 (59.8%) of the women had primary school education with slightly over a quarter (29.9%) having secondary education or higher. Majority of the women resided in rural areas (76.5%), most of the women belonged to either the Anglican or Catholic denomination (70.7%) and were employed (79.0%). Over half (41.4.%) of the women belonged to the poor wealth index bracket. Nearly three quarter (72.1%) of the women resided in communities that were inaccessible to the health facility. Over half (50.2%) of women belong to communities that were socioeconomically disadvantaged. Slightly above three quarters of the women (80.2%) belonged to a less diverse community. A higher proportion (51.5%) of women belonged to communities which are not media saturated (See Table 1).

Prevalence of timing of first ANC visit across the explanatory variables

Table 1 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, 95%CI; 0.28–0.31) 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, woman's parity, household size, education, Community Ethnicity diversity index.

Over one eighth (16.7%) 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 (3.8%), women aged 30 to 39 years (7.7%) 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 (1.3%) respectively. A higher proportion (12.49%) of women who had four or more children made their first ANC visit compared to their counterparts with 2 to 3 children (11.04%) and 1 child (6.15%). Only 9.6%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 (9.3%) and 10.8% who resided in households with fours or less members and 5 to 6 members respectively. Over one eighth (17.16%) of women with primary education utilized ANC services during the first trimester as compared to those with no education and secondary or higher level of education (3.4 and 9.08% respectively). The proportion of women who utilized ANC services in the first trimester was significantly higher (26.93%) for women residing in from communities which are not ethnically diverse compared to their counterparts who resided communities which are not ethnically diverse (2.8%) (See Table 1).

Measure of association (fixed effects) results

Model 4 in Table 2 contains individual and community level variables. In this model, timing of first ANC utilization was association with partially with marital status, parity, community distance to health facility, and community ethnicity diversity. The odds of utilizing ANC services in the first trimester remained higher among formerly married (AOR, 1.35, CI; 0.99–1.83) compared to the never married (single). Women who had four or more children were less likely to utilize ANC during the first trimester compared to those who had only a child (AOR, 0.74, CI; 0.60–0.92). Further, women who lived in communities that were accessible to the nearest health facility were almost three times more likely to attend ANC

Table 1 Shows the background characteristics and percentage of timing for first ANC Services utilization by selected individual and household characteristics and the level of statistical associations

Variables	Number (weighted N, %) $N = 9443$	ANC visits during the first trimester (Weighted %)	Confidence Interval (CI) 95% CI	*P*-value
INDIVIDUAL VARIABLES				
Age at last birth				0.003
<=19	1286 (13.67)	3.79	[12.86–14.52]	
20–29	5020 (53.64)	16.87	[52.44–54.85]	
30–39	2640 (27.44)	7.69	[26.38–28.53]	
40+	497 (5.25)	1.33	[4.758–5.78]	
Marital Status				0.006
Single	532 (5.65)	1.50	[5.076–6.289]	
Married	4032 (40.59)	12.72	[39.02–42.17]	
Living together	3735 (40.87)	11.38	[39.33–42.44]	
Previous married	1144 (12.88)	4.08	[12.03–13.79]	
Household Head				0.715
Male	6899 (73.06)	21.77	[71.76–74.32]	
Female	2544 (26.94)	7.91	[25.68–28.24]	
Parity				0.000
1	1857 (20.21)	6.15	[44.23–47.03]	
2–3	3169 (34.17)	11.04	[32.99–35.36]	
4+	4417 (45.63)	12.49	[44.23–47.03]	
Family Size				0.000
<=4	3073 (33.54)	10.80	[32.21–34.9]	
5–6	2941 (30.93)	9.28	[29.91–31.97]	
7+	3429 (35.53)	9.60	[34.21–36.86]	
Level of Education				0.031
No education	1176 (10.31)	3.44	[9.395–11.31]	
Primary	5764 (59.78)	17.16	[58.09–61.44]	
Secondary or Higher	2503 (29.91)	9.08	[28.17–31.7]	
Place of Residence				0.760
Urban	1969 (23.53)	7.07	[74.79–78.07]	
Rural	7474 (76.47)	22.61	[21.93–25.21]	
Wealth Index				0.733
Poor	4412 (41.19)	12.02	[39.12–43.3]	
Middle	1752 (18.96)	5.67	[17.78–20.18]	
Rich	3279 (39.85)	11.99	[37.49–42.26]	
Religion				0.084
Anglican	2981 (31.11)	9.20	[29.58–32.68]	
Catholic	3931 (39.56)	12.30	[37.66–41.49]	
Muslim	1085 (13.81)	3.92	[12.32–15.44]	
Other's	1446 (15.52)	4.45	[14.31–16.82]	
Employment Status				0.116
Unemployed	1877 (21)	5.85	[19.76–22.29]	
Employed	7566 (79)	23.83	[77.71–80.24]	
COMMUNITY VARIABLES				
Community Distance to Health Facility				0.074
Inaccessible	6540 (72.59)	16.95	[71.03–74.1]	
Accessible	2758 (27.41)	12.95	[25.9–28.97]	
Community Socioeconomic Status				0.329
Low	5400 (50.24)	15.24	[46.68–53.79]	
High	4043 (49.76)	14.44	[46.21–53.32]	

Table 1 (continued)

Variables	Number (weighted N, %) $N = 9443$	ANC visits during the first trimester (Weighted %)	Confidence Interval (CI) 95% CI	*P*-value
Community Ethnicity Diversity Index				0.000
Less Diverse	7473 (80.21)	16.52	[78.76–81.59]	
More Diverse	1970 (19.79)	13.16	[18.41–21.24]	
Community Media Saturation				0.112
Less Saturated	5235 (51.47)	15.82	[47.79–55.14]	
Saturated	4208 (48.53)	13.86	[44.86–52.21]	

during the first trimester, compared to those who resided in Inaccessible communities (AOR, 1.36, CI; 1.04–1.77). Women who lived in ethnic diverse communities were less likely to utilize ANC in the first trimester, compared to their counterpart (AOR, 0.15, CI; 0.11–0.22).

Measure of variations (random effects) results

The random intercept of Model 1 shows that utilization of ANC in the first trimester was statistically significant across the Enumerated Areas (EA)($\tau = 0.76$, 95%CI; (0.62–.93). The model 1 revealed that 19% of the variation in the utilization of ANC in the first trimester was associated to the between-EA variation (ICC = 0.19). The between-EA difference decreased from 19% in Model 1 to 18.0% that had only the individual and community level factors (Model 2). The between-EA difference increased from 18% Model 2 to 23% in the community-level only (3). Lastly, ICC decreased to 22% in the complete model that contained both the individual and community-level factors. This means that the differences in the probability of utilization of timing of ANC in the first trimester can be explained by the variances across the EAs. The overall model fit statistics AIC shows a successive decrease, which shows that there is considerable improvement from the empty model to the final model. This confirms the goodness of fit of final model established in the analysis. Therefore, Model 4 was chosen for forecasting the utilization of ANC in the first trimester among women in Uganda (See Table 2).

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 [17, 18, 36, 52, 53]. 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, and parity. 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 [17, 20]. 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 [21, 22].

Women of higher parity are less likely to utilize antenatal care in the first trimester compared to those with lower parity. The main reasons for late attendant of antenatal care could be attributed to poor attitudes towards ANC and previous pregnancy experiences regarding ANC attendance. For instance, a study was conducted in Mulago hospital which is the main referral hospital in Uganda, the reasons women gave for late ANC attendance were, "I was busy", "I was lazy", "I got tired of attending antenatal care in previous pregnancies", "I have had children before [54].

Community contextual factors associated with timing of antenatal care service utilization included the community mean distance to the nearest health facility, community ethnicity diversity. 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 [55, 56]. Studies in sub–Saharan Africa opined distance as a factor in the

Table 2 Multilevel Analysis of Odd Ratios on the effect of Individual, Household and Community level factors in influencing the timing of ANC Utilization in Uganda, UDHS 2016

Variables	Model 1 Empty Model Odd Ratio (95% CI)	Model 2 Individual level Odd Ratio (95% CI)	Model 3 Community level Odd Ratio (95% CI)	Model 4 Individual/Community level AOR (95% CI)
INDIVIDUAL VARIABLES				
Age at last birth				
<=19		1.00		1.00
20–29		1.18 (0. .97–1.44)		1.18 (0.97–1.44)
30–39		1.12 (0.89–1.42)		+1.14 (0.89–1.46)
40+		1.05 (0.70–1.41)		1.05 (0.73–1.51)
Marital Status				
Single		1.00		1.00
Married		1.13* (1.01–1.70)		1.25 (0.95–1.64)
Living together		1.11 (0.86–1.44)		1.05 (0.81–1.37)
Previous married		1.41* (1.05–1.89)		1.35 (0.99–1.83)
Parity				
1		1		1.00
2–3		0.93 (0.78–1.11)		0.89 (0.75–1.07)
4+		0.78* (0.63–0.96)		0.74* (0.60–0.92)
Family Size				
<=4		1.00		1.00
5–6		0. .94 (0.78–1.11)		0.95 (0.81–1.12)
7+		0.87 (0.63–0.96)		0.85 (0.72–1.01)
Level of Education				
No education		1.00		
Primary		0.93 (0.77–1.13)		
Secondary or Higher		1.001 (0.80–1.26)		
Religion				
Anglican		1.00		1.00
Catholic		0.95 (0.83–1.09)		0.99 (0.86–1.15)
Muslim		0.84 (0.68–1.05)		0.89 (0.71–1.11)
Other's		0.97 (0.79–1.13)		0.96 (0.80–1.15)
Employment Status				
Unemployed		1.00		1.00
Employed		1.16 (0.99–1.35)		1.17 (0.99–1.37)
COMMUNITY VARIABLES				
Community Distance to Health Facility				
Inaccessible			1.00	1
Accessible			1.35**(1.04–1.75)	1.36*(1.04–1.77)
Community Ethnicity Diversity Index				
Less Diverse			1.00	1.00
More Diverse			0.15***(0.11–0.22)	0.15***(0.11–0.22)
Community Media Saturation				
Less Saturated			1.00	
Saturated			0.89 (0.71–1.13)	
Random effect results:				
PSU Variance (95% CI)	0.757(0.62–.93)	0.734(0.60–0.90)	0.987(0.793–1.229)	0.965(0.78–1.20)
ICC	0.19	0.18	0.23	0.23
Wild chi-square and p-value	Ref	$\chi^2 = 37.73, p < 0.003$	$\chi^2 = 116.70, p < 0.000$	$\chi^2 = 159.31, p < 0.000$

Table 2 (continued)

Variables	Model 1 Empty Model	Model 2 Individual level	Model 3 Community level	Model 4 Individual/Community level
	Odd Ratio (95% CI)	Odd Ratio (95% CI)	Odd Ratio (95% CI)	AOR (95% CI)
Model fitness:				
Log-likelihood	−2,041,788.8	−2,031,440.7	−1,894,570.9	−1,885,488
AIC	4,083,582	4,062,917	3,789,152	3,771,012
PSU	649	649	649	649
N	9443	9443	9298	9298

The Empty Model contain no variables, but it partitioned the variance into two component parts. *AIC* Akaike Information Criterion, *CI* Confidence Interval,® Reference category,® reference category, *AOR* Adjusted Odd Ratio's, *ICC* Inter-classical correlations, Significant level, ***p = <.001, **p < .01, *p < .05. *PSU* Primary sampling unit, *N* Number

utilization of health facilities [44, 57–59]. For instances, Gabrysch and Campbell [58] 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.

Community ethnicity diversity was associated with timing of antenatal care services. Women who reside in diverse community were less likely to utilize ANC in the first trimester, compared to their counterparts. The main reason associated to this could be that communities which are homogenous share common norms, which enables cooperation among co-ethnics in terms of information sharing could be easier compared to heterogenous communities. The findings from this study is in line with other studies in Uganda and elsewhere which established an association between ethnicity diversity and healthcare seeking behaviour [39, 60].

Limitation and strength of the study

This study has its own limitations and the first there is and 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 other limitations could be associated with community-level factors which were aggregated from individual-level information, these could lead to ecological fallacy. Despite these limitations, this study used the recent multilevel methodology suggested by DHS which involves weight approximation, this has contributed greatly to the body of knowledge regarding multilevel analysis. The outcome variable 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 using ArcGIS software on 685 out of 696 enumeration areas whose coordinates were found to be valid from each EA 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 [46] 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 ethnicity diversity. 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 which are ethnically diverse were more likely to utilize ANC services during their first trimester. Individual level factors associated with the timing of first ANC included marital status, and parity. Policy interventions geared towards improving the quality of maternal and child health services in the nearest health facilities are recommended. Health education programs which target women of higher parity to encourage them to attend ANC in the first trimester is encourage. This study is mainly quantitative, there is need to combine qualitative and quantitative study to understand the root cause of late utilization of ANC.

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; AOR: Adjusted Odd Ratios.

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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. All authors read and approved the final manuscript.

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Availability of data and materials
The dataset can be accessed through this website; https://dhsprogram.com/data/dataset_admin/login_main.cfm?CFID=6055127&CFTOKEN=416a39e1e52181a9-CCE2DAA5-A212-565C-40BD6F8E8C8E5041. Registration is required. This study used the UGIR70FL (Individual Recode –Women with completed interviews – Uganda, 2016).

Declarations

Ethics approval and consent to participate
The authors have requested permission to use the UDHS datasets from the DHS program website https://www.dhsprogram.com/data/available-datasets.cfm. The demographics and health survey also anonymized all data before making it publicly available. The ICF IRB reviewed and approved the 2016 Uganda Demographic and Health Survey. The ORC MACRO, ICF Macro, and ICF IRBs complied with US Department of Health and Human Services regulations for the protection of human subjects (45 CFR 46). All participants gave their informed verbal consent to participate in the study and, for minors, their parents or legal guardians consented on their behalf. Further details on the conduct of the study can be found in the 2016 UDHS report [12, 61] and also more details about the data and ethical standards are available at http://goo.gl/ny8T6X. Further, the authors would like to confirm that all methods were carried out in accordance with relevant guidelines and regulations in the Helsinki declaration.

Consent for publication
Not required.

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

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