

Dimensions of women's empowerment on access to antenatal care in Uganda: a further analysis of the Uganda demographic health survey 2016

Sserwanja Quraish

GOAL Sudan <https://orcid.org/0000-0003-0576-4627>

Kawuki Joseph (✉ joseks256@gmail.com)

The Chinese University of Hong Kong

Nabbuye Rehemah

Ice Breakers Uganda

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Abstract

Background: Women empowerment has been viewed as a good strategy in the reduction of global maternal morbidity and mortality. Most of the recent studies in Uganda have focused on ANC frequency and the associated factors with no focus on the effect of women empowerment. Our study aims at examining the prevalence of optimal access to ANC by considering timing of initiation, type of ANC provider and ANC frequency and their association with women empowerment.

Methods: We used Uganda Demographic and Health Survey (UDHS) 2016 data of 9957 women aged 15 to 49 years. Multistage stratified sampling was used to select study participants and we conducted multivariable logistic regression to establish the association between women empowerment and access to ANC using SPSS version 25.

Results: Out of 9,957 women, 2,953 (29.7%: 95% CI: 28.5.0-30.2) had initiated ANC in first trimester, 6,080 (61.1%: 95% CI: 60.4-62.3) had 4 or more ANC contacts, and 9,880 (99.2%: 95% CI: 99.0-99.3) had received ANC from a skilled provider. Overall, 2,399 (24.1%: 95% CI: 23.0-24.6) had optimal access to ANC. Economic empowerment and exposure to media were the only women empowerment indices that were positively associated with optimal access to ANC. Other factors that were significant include; region, wealth index, age, level of education and working status. Women in younger age groups, those with higher wealth quintiles and those from the Northern and Western regions were also more likely to have optimal access to ANC compared to their older, poorest quintile and Eastern region counterparts respectively.

Conclusion: To ensure increased access to ANC, policy-makers and other stakeholders should prioritize use of mass media in maternal health programs, equitable allocation of the limited financial resources with a focus on older, poor and uneducated women.

Introduction

Globally, the definition of empowerment has varied substantially and measuring empowerment has proven to be difficult ¹. It is therefore commonly inferred by indicators, such as decision-making, financial independence, or mobility freedom ². Women empowerment has been viewed as a good strategy in the reduction of global maternal morbidity and mortality ¹. Autonomous women have been shown to have better maternal health seeking behavior and better maternal and child health outcomes ^{3,4}. Globally, over half of maternal mortalities are due to pregnancy-related complications and over 90% of these deaths are from low and middle income countries ⁵. Majority of these maternal deaths are preventable through skilled birth attendance and increased antenatal care (ANC) contacts ⁵. Focused antenatal care has been shown to increase the likelihood of skilled birth attendance ^{1,6} and also gives health workers an opportunity to advise pregnant women on essential pregnancy care to reduce malnutrition, stillbirths, maternal mortality and morbidity, and neonatal deaths ^{5,7}.

Proper access to ANC has been shown to reduce maternal mortality by up to 8 per 1000 live births ⁵. Globally, progress to achieve universal antenatal care (ANC) coverage is tracked mainly by the ability to have contact with a skilled health provider during ANC and the number of ANC visits/ contacts ⁸. Although the number of contacts do not guarantee good quality of ANC, in theory, the more points of contact that a woman has with a well-functioning and effective health system, the higher the likelihood of earlier prevention, detection and treatment of potential pregnancy complications ⁸. ANC quality is tracked by three dimensions: number of visits, timing of initiation and content of the care received ⁹. The timing of initiation of ANC, ANC provider and the total number of ANC contacts have been shown to affect the content and quality of ANC received ⁹. Early initiation and increased ANC contacts have been reported to be associated with reduced low birth weights and lower infant mortality ^{9,10}.

Over the last two decades, Uganda has achieved a steady reduction in the maternal mortality ratio (MMR) currently standing at 336 deaths per 100,000 live births with substantial variation across Ugandan regions ¹¹. Despite the reduction in MMR, the current ratio remains a concern if we are to achieve the Sustainable Development Goal (SDG) 3 target of less than 70 maternal deaths per 100,000 live births by 2030 ¹². Benova et al. conducted a repeated cross-sectional study using four UDHS data (1995, 2000, 2006 and 2011) where it was shown that ANC coverage was high over 90% from 2001 to 2011 however, there was insufficient ANC frequency ¹³. Less than half of the women had received four or more ANC contacts and only 10% of these women who had received four or more contacts had received all the required ANC components ¹³. However, this study defined optimal ANC care with only number of ANC contacts and type of provider and only looked at four independent variables (region, wealth, residence, level of education and wealth index).

Most of the other recent studies in Uganda have mainly focused on ANC frequency alone and the associated factors with no focus on the effect of women empowerment on access to ANC. Yet women disempowerment may negatively affect the utilization and quality of ANC services ⁹. Decisions regarding access to healthcare may be made exclusively by men and for the women who may access ANC, limited financial and decision making abilities may negatively affect the possibility of implementing the recommended practices at home. In order to ensure proper and effective implementation of the new WHO ANC guidelines aimed at reducing maternal mortality and morbidity ¹⁴, there is need to evaluate access to ANC at a national level with the most recent data. Therefore, our study aims at examining the prevalence of optimal access to ANC by considering timing of initiation, type of ANC provider and ANC frequency and the association with women empowerment. This is the first study in Uganda to look at the three indicators of access to ANC and the association with women empowerment.

Methods

Data source

We used data from the 2016 UDHS which was a nationally representative population based cross-sectional survey funded by the United States Agency for International Development (USAID) implemented between 20th June 2016 to 16th December 2016 by the Uganda Bureau of Statistics. UDHS is a periodical survey that is carried out every five years as part of the MEASURE DHS global survey and collects Information on demographic, health and nutrition indicators. The UDHS used stratified two-stage cluster sampling design that resulted in the random selection of a representative sample of 20,880 households¹¹. A detailed explanation of the sampling process is available in the UDHS 2016 report¹¹. Women who were aged 15–49 years and were permanent residents of the selected households or visitors but had stayed in the household the night before the survey were eligible for inclusion in the survey.

Our secondary analysis included women who had given birth in the last 5 years preceding the survey and had attended at least one ANC contact. Out of the total 18,506 women in the survey, 10,263 women had given birth in the last 5 years preceding the survey, and a final weighted number of 9,957 women had attended at least one ANC contact. Where a woman had more than one birth in the last 5 years, ANC information for the most recent birth was considered. UDHS 2016 had four different questionnaires that included; household, men's, women's and the biomarker questionnaires. Our secondary analysis used data collected by the women's and household questionnaires that focused on women's background characteristics, reproductive health, domestic violence and nutrition. Women were asked a number of questions about antenatal health care that included; type of ANC provider, the number of ANC visits, the timing of the first ANC visit and the components included in the ANC provided.

Study Setting

Uganda currently has a population of about 44 million people¹⁵. Uganda's health system has six levels ranging from the highest level of national referral hospitals to the lowest level at the community level¹⁶. Agriculture is the main source of income for the 84% of Ugandans living in rural areas¹⁶. The Ugandan government abolished user fees in 2001 in all public health facilities. However, the health system still faces inadequate staffing, low pay, shortage of medicines and poor infrastructure that have negatively affected health service provision and utilisation¹⁷. The private sector owns almost half of Uganda's health facilities¹³. However, less than 20% of these private health facilities are at the level of health centre III or above, which is the minimum level at which maternal health services are to be provided¹³.

Variables

Outcome variable

Based on WHO's definition of 'effective ANC' and previous studies^{9, 18, 19} regarding quality and access of ANC, a final criterion was developed for determining optimal access to ANC. The outcome variable 'optimal access to ANC' was measured as a composite index and was dichotomized. The outcome optimal access to ANC was coded as 1 and suboptimal access as 0. Three indicators were used to define access to ANC and these included; timing of initial visit, number of visits and provider of the ANC.

Optimal access to ANC was considered as ANC package that was initiated in the first trimester, included a minimum of four ANC contacts and was provided by a skilled health provider ^{13,20}. Timing of initiation of contacts describes how many months of pregnancy a woman was during her first ANC contact. This was initially numerical ranging from 0-10 months and was categorized as: 'first three months' (coded as 1) and 'more than three months' (coded as 0). Total number of ANC contacts is the number of times a woman received ANC and was initially a numerical variable categorized as 'four or more visits' (coded as 1) and 'less than 4 visits' (1-3 visits and coded as 0). We considered a minimum of four visits since it was the recommendation of WHO at the time of the survey. Type of ANC provider referred to the service provider who provided ANC to the woman in her last pregnancy. It was categorized as the 'skilled provider' (doctor, clinical officer, nurse and midwife coded as 1) and 'non-skilled provider' (coded as 0). Where multiple providers provided care to one woman, the highest skilled provider was recorded. The total score from the three indicators for each woman was determined, with the maximum score being '3' if the woman initiated ANC in the first trimester, had a minimum of four ANC visits and was seen by a skilled provider. Score of 3 was considered as optimal ANC access and any score below 3 was considered as suboptimal ANC access.

Explanatory variables

Measures of women's empowerment

Four indices were created to measure empowerment of women: decision making, economic empowerment, sexual empowerment and exposure to media indices. Women's empowerment indices were measured as composite scores ^{1, 19, 21}.

Decision making included women's ability to be involved in making decisions regarding; their own health; large household purchases; visits to their family and control over their earnings ⁵. Re-coding to the responses was done to have two categories (1 = woman involved in decision making alone or with partner, 0 = woman not involved in decision making). To create an index, we added up all the scores for each woman with the total score ranging from 0 to 4 and we finally categorized the score into four groups. The highest score was four which meant that the woman was involved in the decision making for the four used indicators. Medium decision making ability meant that women were involved in 2 or 3 indicators, low decision making meant that the woman was involved in only one indicator and no decision making meant that the woman was not involved in any decision making ^{21, 22}. Decision making had about 1,846 missing responses since these questions were asked during the domestic violence survey sessions and yet not all women in the UDHS were included in the domestic violence section of the survey. These missing observations were assumed to be zero ¹⁹ and hence we risked overestimating low decision making. To ensure that this doesn't affect our findings, we did a sensitivity analysis where we only considered women who had decision making responses and excluded those who were missing decision making responses. This showed no significant difference with the original analysis and more details are included in the sensitivity analysis section of the results. For background characteristics, we provided

frequencies of decision making considering only women who had responded to decision making questions.

Economic empowerment included women's owning of a house, land and the type of earning from her work^{22,23}. Each of the three economic empowerment indicators was re-coded 1 if the women owned a house or land (either alone or jointly with a partner) or received cash payment for their work and 0 if not owning a house, land or cash payment for work. To create an index, we added up all the scores for each woman with the total score ranged from 0 to 3 and we finally categorized the score into four groups. The highest score was 3 which meant that the woman was owning a house, land and earned cash for her work. Score 2 was considered medium economic empowerment, score 1 considered low economic empowerment and 0 no economic empowerment.

Sexual empowerment was considered as women's ability to refuse sex and ask a partner to use condoms^{23,24}. Responses were coded (1 if the woman could refuse sex or ask for a condom and 0 if the woman could not) and sexually empowered women were those who were able to refuse sex or ask their partners to use condoms. To create an index, we added up all the scores for each woman with the total score ranged from 0 to 2 and we finally categorized the score into three groups. Highest score was 2 and these were considered to have high sexual empowerment, score 1 low sexual empowerment and 0 as no sexual empowerment.

Exposure to media was considered as the women's ability to have the opportunity to read newspaper or a magazine, listen to the radio and watch TV. Responses were re-coded (1 if the woman was exposed to newspaper, radio or TV and 0 if the woman was not). To create an index, we added up all the scores for each woman with the total score ranged from 0 to 3 and we finally categorized the score into four groups²¹. A value of 0 meant no access to any of the three, 1 exposure to only one medium (low), 2 as exposure to only two (media) and 3 as exposure to all the three media channels (high)^{21,22}.

Other explanatory variables or potential confounders

We included determinants of ANC access basing on available literature and data^{1,25,26}. Ten variables were considered and of these, two were community level factors that included; place of residence categorized into rural and urban, and region of residence categorized into Central, East, West and North. Two household level factors included; household size which was categorized into less than six and six and above and wealth index that was categorized into quintiles that ranged from the poorest to the richest quintile. Wealth index was calculated by DHS from information on household asset ownership using Principal Component Analysis. Six individual/maternal level factors were included in the analysis and these were; age (categorized as 15-24, 25-34, 35-49), parity (categorized as 0-4 and above 4), working status (categorized as working and not working), marital status (categorized as married and unmarried), health insurance (categorized as having insurance and not having) and level of education (categorized as no education, primary, secondary and tertiary levels).

Statistical analysis

We used the SPSS analytic software version 25.0 Complex Samples package for this analysis. Weighted data was used to account for the unequal probability sampling in different strata. Frequency distributions were used to describe the background characteristics of the women. We used cross-tabulations to examine associations between ANC access and women's empowerment indicators and socio-demographic factors. Pearson's chi-squared tests were used to investigate the significant differences between ANC access and the explanatory variables with the level of statistical significance set at p-value < 0.25.

Bivariable logistic regression was also conducted and we present crude odds ratio (COR), 95% confidence interval (CI) and p-values. Independent variables found significant at p-value less than 0.25 were included in the multivariable model. Independent variables that were non-significant at bivariable analysis level but had been shown to be associated with access to ANC in previous studies were also included in the multivariable logistic regression models. Two models were constructed in the multivariable analysis; one with only women empowerment variables and the final model that included the women empowerment and other variables. Adjusted odds ratios (AOR), 95% Confidence Intervals (CI) and p-values were calculated with statistical significance level set at p-value < 0.05. We conducted sensitivity analysis where we separated the three indicators of optimal ANC access and we analyzed the association between women empowerment and each of the indicators (timing, frequency and provider) separately. Further sensitivity analysis was done with eight or more ANC contacts as the outcome and lastly, analysis where we only considered women with decision making responses and excluded those who had these responses missing. All variables in the model were assessed for collinearity, which was considered present if the variables had a variance inflation factor (VIF) greater than 10. However, none of the factors had a VIF above 3.

Results

A total of 9,957 women were included in this study (**Table 1**). Of these, 2,399 (24.1%) (95% CI: 23.0-24.6) had initiated ANC in the first trimester, had 4 or more ANC contacts and received ANC provided by a skilled provider. Majority of the women were residing in rural areas (76.7%), married (81.5%), working (79%) and had primary as highest level of education (59.8%). The mean age of study participants and household size were 28.3 ± 7.12 and 5.99 ± 2.79 respectively. Access to ANC indicators have been shown in **Table 2**.

Table 1: Background characteristics of Ugandan women aged 15 to 49 years as per the 2016 UDHS

Category	Frequency (N=9957)	Percent (%)
Age		
15 to 24	3494	35.1
25 to 34	4355	43.7
35 to 49	2108	21.2
Residence		
Urban	2316	23.3
Rural	7641	76.7
Region		
Western	2485	25.0
Eastern	2682	26.9
Central	2752	27.6
Northern	2037	20.5
Parity		
0-4	6601	66.3
5 and above	3356	33.7
Household Size		
6 and Above	4939	49.6
Less than 6	5018	50.4
Working status		
Not working	2093	21.0
Working	7864	79.0
Marital status		
Married	8111	81.5
Not married	1846	18.5
Education Level		
No Education	1028	10.3
Primary Education	5957	59.8
Secondary Education	2260	22.7

Higher	712	07.1
Wealth Index		
Poorest	2060	20.7
Poorer	2031	20.4
Middle	1897	19.0
Richer	1820	18.3
Richest	2149	21.6
Economic Empowerment		
High	1934	19.4
Medium	2557	25.7
Low	3638	36.5
None	1828	18.4
Exposure to Media		
High	1156	11.6
Medium	2156	21.7
Low	4439	44.6
None	2206	22.2
Decision Making		
High	2657	32.8
Medium	3486	43.0
Lowest	1062	13.1
No	906	11.2

Sexual Empowerment		
High	5946	59.7
Low	1509	15.2
No	2502	25.1
Health Insurance		
Yes	127	1.3
No	9830	98.7

Table 2: Access to ANC indicators of Ugandan women per the 2016 UDHS

Characteristics	Frequency (N=9957)	Percent (%)	95% CI
ANC Initiation Timing^a			
First trimester	2953	29.7	28.5-30.2
After first trimester	6994	70.2	
ANC visits^b			
Less than 4	3821	38.4	
4 and above	6080	61.1	60.4-62.3
ANC provider			
Skilled	9880	99.2	99.0-99.3
Un skilled	77	00.8	
Access to ANC			
Optimal	2399	24.1	23.9-24.6
Suboptimal	7558	75.9	

^a10 missing, ^b56 missing

Factors associated with Optimal access to ANC

Table 3 shows results of bivariable analysis. In the final logistic regression model, only economic empowerment and exposure to media were positively associated with optimal access to ANC. Other socio-demographic factors that were significant include; region, wealth index and age as indicated in **Table 4**. Women with exposure to media and those with economic empowerment were shown to have optimal access to ANC compared to those with no exposure to media or economic empowerment. Women in younger age groups, those with higher wealth quintiles and those from the Northern and Western regions were also more likely to have optimal access to ANC compared to their older, poorest quintile and Eastern region counterparts respectively.

Table 3: Bivariable analysis and distribution of ANC access by socio-demographic characteristics

Characteristics	Sub-optimal ANC	Optimal ANC	P-Value	Crude model COR (95%CI)	P-value
Empowerment					
Decision making			0.032		0.082
None	2106 (27.9)	645(26.9)		1	
Low	832 (11.0)	230(09.6)		0.90 (0.74-1.10)	
Medium	2651 (35.1)	835 (34.8)		1.03 (0.90-1.17)	
High	1969 (26.1)	688 (28.7)		1.14 (0.99-1.31)	
Economic Empowerment			0.001		0.005
None	1448 (19.2)	380(15.8)		1	
Low	2764 (36.6)	874 (36.4)		1.21 (1.03-1.42)	
Medium	1915 (25.3)	642 (26.8)		1.28 (1.09-1.50)	
High	1431 (18.9)	503 (21.0)		1.34 (1.13-1.59)	
Media Exposure			<0.001		0.001
None	1717 (22.7)	489 (20.4)		1	
Low	3411 (45.1)	1027(42.8)		1	
Medium	1595 (21.1)	561(23.4)		1.06 (0.92-1.21)	
High	835 (11.1)	321(13.4)		1.24 (1.04-1.46)	
				1.35 (1.09-1.66)	
Sexual Empowerment			0.547		0.546
None	1905(25.2)	597(24.9)		1	
Low	1128 (14.9)	382(15.9)		1.08(0.92-1.27)	
High	4526(59.9)	1420(59.2)		1.00(0.89-1.18)	
Other variables					
Wealth Index			0.203		0.459
Poorest	1590 (21.0)	470 (19.6)		1	

Poorer	1554 (20.6)	477 (19.9)	1.04 (0.88-1.23)
Middle	1448 (19.2)	448 (18.7)	1.04 (0.89-1.23)
Richer	1368 (18.1)	451 (18.8)	1.11 (0.94-1.32)
Richest	1597 (21.1)	552 (23.0)	1.15 (0.96-1.38)
Working Status			0.003
Working	1640(21.7)	453 (18.9)	1
Not Working	5918 (78.3)	1946(81.1)	0.84 (0.73-0.96)
Education Level			<0.001
No Education	764 (10.1)	264 (11.0)	1
Primary	4576 (60.5)	1381(57.6)	0.88 (0.73-1.05)
Secondary	1731 (22.9)	530 (22.1)	0.89 (0.72-1.09)
Higher	488 (6.5)	224 (9.3)	1.33 (1.01-1.76)
Region			<0.001
Eastern	2157 (28.5)	525 (21.9)	1
Western	1787 (23.6)	698 (29.1)	1.60 (1.34-1.91)
Central	2169 (28.7)	583 (24.3)	1.11 (0.92-1.33)
Northern	1445 (19.1)	593 (24.7)	1.69 (1.43-1.99)
Marital Status			0.639
Married	6149 (81.4)	1962(81.8)	1
Not Married	1409 (18.6)	437 (18.2)	0.97 (0.84-1.11)
Age			<0.001
35 to 49	1676 (22.2)	432(18.0)	1
25 to 34	3220 (42.6)	1135(47.3)	1.37 (1.19-1.58)

15 to 24	2662 (35.2)	832 (34.7)	1.21 (1.05-1.41)	
Residence			0.076	0.213
Rural	5832 (77.2)	1809(75.4)	1	
Urban	1726 (22.8)	590 (24.6)	1.10 (0.95-1.29)	
Household Size			0.012	0.036
Six and Above	3803 (50.3)	1136(47.4)	1	
Less than 6	3756 (49.7)	1263(52.6)	1.16 (1.01-1.26)	
Parity			<0.001	<0.001
Above 4	2629(34.8)	727(30.3)	1	
0-4	4929(65.2)	1672(69.7)	1.23 (1.09-1.37)	
Health Insurance			0.034	0.096
No	7472(98.8)	2358(98.3)	1	
Yes	87 (1.2)	40(1.7)	1.49 (0.93-2.39)	

bold= Significant at p-value <0.25

Table 4: Predictors of optimal ANC access as per UDHS 2016

Characteristics	Adjusted Model I AOR (95%CI)	Adjusted Model II AOR (95%CI)
Empowerment		
Decision making		
None	1	1
Low	0.90 (0.73-1.13)	0.85 (0.66-1.10)
Medium	1.00 (0.85-1.19)	0.90 (0.74-1.10)
High	1.10 (0.92-1.30)	0.95(0.77-1.16)
Economic		
None	1	1
Low	1.17 (0.98-1.38)	1.12 (0.92-1.36)
Medium	1.27 (1.08-1.49)	1.22 (1.02-1.45)
High	1.31 (1.09-1.57)	1.19 (0.97-1.46)
Sexual		
None	1	1
Low	1.05 (0.86-1.28)	1.07 (0.85-1.36)
High	0.95(0.81-1.11)	0.98 (0.79-1.20)
Media Exposure		
None	1	1
Low	1.05 (0.91-1.20)	1.05 (0.91-1.21)
Medium	1.25 (1.05-1.48)	1.33 (1.11-1.59)
High	1.35 (1.10-1.66)	1.44 (1.14-1.83)
Other variables		
Wealth Index		
Poorest		1
Poorer		1.18 (0.99-1.41)
Middle		1.21 (1.01-1.45)
Richer		1.30(1.07-1.57)
Richest		1.28(1.01-1.65)
Working Status		

Working	1
Not Working	0.92 (0.78-1.09)
Education Level	
No Education	1
Primary	0.85 (0.70-1.02)
Secondary	0.81 (0.65-1.02)
Tertiary	1.05 (0.77-1.45)
Region	
Eastern	1
Western	1.51 (1.26-1.80)
Central	0.90 (0.73-1.11)
Northern	1.80 (1.52-2.12)
Marital Status	
Married	1
Not Married	0.94 (0.71-1.25)
Age	
35 to 49	1
25 to 34	1.33 (1.12-1.56)
15 to 24	1.23 (1.01-1.50)
Residence	
Rural	1
Urban	1.02 (0.86-1.20)
Household Size	
Six and Above	1
Less than 6	1.05 (0.93-1.19)
Parity	
Above 4	1
0-4	1.07 (0.91-1.25)
Health Insurance	

No	1
Yes	1.26 (0.76-2.08)

bold= Significant at p-value <0.05

Sensitivity analysis

Analysis after excluding women whose responses on decision making were missing.

Decision making as an indicator of women empowerment remained non-significant even after considering only women with no missing responses. Like the original analysis, five independent factors were significant here of which two were women empowerment indicators (exposure to media and economic empowerment). The other factors that were significant included; age, wealth index and region. No significant differences were observed between the associations here and those in the original analysis.

Factors associated with four or more ANC contacts

Seven factors were significantly associated with frequency of ANC and these included two women empowerment indicators (economic empowerment and exposure to media), level of education, age, region, working status and wealth index. Unlike in the overall analysis of optimal ANC access, level of education was observed to be significant and higher levels were associated with higher ANC frequency. Women with secondary (**AOR: 1.24 95% CI: 1.02-1.50**) and tertiary (**AOR: 1.52 95% CI: 1.16-2.01**) levels of education were 24% and 52% respectively more likely to have 4 or more ANC visits compared to those with no level of education. Similarly, working status was significant here unlike the overall analysis. Women who were not working (**AOR: 0.87 95% CI: 0.76-0.99**) were 13% less likely to have four or more ANC visits compared to those who were working. Compared to the overall analysis, no significant differences were observed here with the associations with age, wealth index, region, economic empowerment, and exposure to media.

Factors associated with eight or more ANC contacts

Only 187 (1.9%) (**95% CI: 1.5-2.1**) of the women had attended eight or more ANC contacts. Three factors were positively associated with ANC frequency of 8 or more and these included exposure to media, wealth index and region. Exposure to media was the only women empowerment indicator that was significantly associated with eight contacts or more and the association was stronger compared to the one in the overall analysis. Women with medium (**AOR: 2.24 95% CI: 1.15-4.35**) and high (**AOR: 2.25 95% CI: 1.13-5.56**) media exposure were 124% and 125% respectively to have 8 or more ANC contacts. Unlike in the overall analysis, the association between region and ANC frequency was stronger and only with the Central region. Women from the central region (**AOR: 3.21 95% CI: 1.86-5.53**) were 221% more likely to have 8 or more ANC contacts compared to those from the East.

Factors associated with timing of ANC initiation

Four factors were positively associated with timing of the initiation of ANC and these included level of education, age, region, and exposure to media. Exposure to media was the only women empowerment factor that was positively associated with timing of ANC initiation and the strength of association did not vary significantly from the overall analysis. Unlike in the overall analysis of optimal ANC access, level of education was significant and higher level of education was negatively associated with earlier timing. Women with primary (**AOR:0.79 95% CI: 0.67-0.93**) and secondary (**AOR:0.75 95% CI: 0.61-0.92**) levels of education were 21% and 25% less likely to initiate ANC in the first trimester respectively compared to those with no education. No significant differences were observed regarding the associations of age and region with ANC initiation timing compared to those with optimal access to ANC in the overall analysis.

Factors associated with type of ANC provider

Only wealth index was significantly associated with type of ANC provider and the association was stronger compared to the overall analysis. Women belonging to the middle (**AOR:2.64 95% CI:1.06-6.57**) and richer (**AOR:3.35 95% CI:1.12-10.08**) quintiles were 164% and 235% more likely to use a skilled ANC provider compared to those from the poorest quintile.

Discussion

To our knowledge, is the first and to-date study to comprehensively examine the association between women empowerment and access to ANC in Uganda. The study showed that only 24.1% of the women had optimal access to ANC. Utilization of ANC was higher than that in Nepal⁹ and Bangladesh²⁷ while slightly lower than that in Central Ethiopia²⁸ and Benin⁵. Earlier timing of ANC initiation was slightly higher by 2.7% compared to that in Nigeria²⁹. The differences in the health facilities' access, health system capacity and economic development among these Countries could also explain the observed differences.

Women's Empowerment and access to ANC

Out of the four indices of women empowerment, only economic empowerment and exposure to media were positively associated with optimal access to ANC. Women who had weekly exposure to all the three media outlets and those exposed to only two media outlets were 44% and 33% respectively more likely to have optimal access to ANC. The association was still observed in the sensitivity analysis with ANC frequency and timing of ANC initiation. The association was stronger with 8 or more ANC contacts compared to the original analysis that looked at optimal access as a composite outcome. Women with medium and high media exposure were 124% and 125% respectively to have 8 or more ANC visits. The influence of media on access to ANC could be attributed to the role media houses play in reducing knowledge gaps by sensitizing women on the benefits of ANC utilization which leads to positive attitudes, challenges negative social norms and improves health seeking behavior^{21, 22}. Furthermore, people who are exposed to media are more likely to have discussions with others which interpersonal interactions contribute greatly in challenging negative norms that might lead to positive health seeking behavioral

change³⁰. Exposure to media has been shown in previous studies to have a positive association with access to ANC^{20,21,26,27}.

Women who were economic empowered were shown to be more likely to have optimal access to ANC compared to their counterparts who were not economically empowered. This association was also observed in the sensitivity analyses regarding ANC frequency. A similar association was observed with wealth index where women who belonged to households with higher wealth quintiles were more likely to have optimal access to ANC compared to those in the poorest quintile. Poverty is a known determining factor of maternal health care utilization in low and middle income countries and women with limited economic resources or low economic empowerment are more likely to afford the direct and indirect costs associated with access to optimal ANC^{26,31,32}. Although Uganda abolished user fees in public health facilities¹⁷, indirect and direct costs such as out of pocket costs for drugs that might not be available in the public hospitals and transport costs pose financial barriers to optimal access to ANC^{27,33}. Women belonging to the lower wealth quintiles and those who are not economically empowered are more likely to have difficulties in meeting transport and indirect costs related to maternal healthcare in government facilities which prevents/limits them from utilizing health facilities³⁴ and this is further worsened by the high costs of private health facilities¹². This is most likely to lead women initiating ANC contacts late, have few or no ANC contacts and have an unskilled ANC provider²⁶. Positive association between economic empowerment and wealth index with access to ANC has been documented in other studies^{25,26,28,33,35}.

In this sample, decision making and sexual empowerment were not significant predictors of optimal access to ANC. Chol et al. examined the association between women's autonomy and maternal healthcare utilization (ANC and skilled birth attendance) across 31 countries in Africa using DHS 2010-2016 data and showed mixed results. Most countries showed significant associations between decision making and sexual empowerment with access and utilization of ANC³³. Similar to our findings, Uganda's country level analysis showed no significant association but the pooled results for East African countries where Uganda was grouped showed weak but significant associations³³. Within the same study, country level analyses of three countries showed a negative association between high decision making ability, sexual autonomy with utilization of ANC³³. Women with higher autonomy in these countries were less likely to utilize ANC³³. Despite the non-significant association between decision making and access to ANC in our study, several other studies have shown a positive association^{9,26,36}. Our analysis combined the four aspects of decision making and we were unable to ascertain whether each aspect has a different effect. Decisions on maternal healthcare seeking have been evidenced to be complex mainly in resource limited settings and depend on various logistical and structural factors²⁴. Furthermore, the uneven distribution of resources and health facilities' availability in the different regions of Uganda might explain the observed non-significant association. Decision making has also been shown to have no significant association with maternal healthcare access and utilization in some previous studies^{22,24,37,38}.

Other demographic factors

Our study also showed age, level of education, wealth index, region and working status as the demographic and socioeconomic variables that were associated with optimal access to ANC. Resources, such as wealth and employment have been often identified as empowerment components or enabling factors³⁷. For example, a woman who is in extreme poverty may not have high access to media or an illiterate woman will not be able to read newspapers.

Younger women were more likely to have optimal access to ANC. A similar positive association was observed even in the sensitivity analyses. Older women usually have higher number of births and tend to develop confidence given their accumulated experience and knowledge from the previous pregnancies, thus they become less motivated to initiate ANC early and to have more ANC contacts²⁶. In addition, older women tend to have more traditional cohorts hence can easily resist modern health care services^{39, 40}. Age as a predictor of health facility utilization during childbirth has also been documented in several other studies^{25, 26}.

Women in the Northern and Western regions were more likely to have access to optimal ANC compared to those in the Eastern region. This was also observed in the sensitivity analyses as well with the association becoming stronger in the 8 or more ANC contacts were women in the Central region were 221% more likely to have 8 or more ANC visits compared to those from the East. The differences in health facilities' distribution and accessibility, sociocultural context and economic development contribute to the observed regional differences in utilization of health facility at birth⁴¹. The central region is more advanced and developed with a high concentration of health facilities and health care workers. Following the civil war, the Northern region has had many interventions and humanitarian aid mainly targeting maternal health services improvement which could partly explain the finding⁴². Besides being one of the poorest region in Uganda, Tetui et al. with data from 15 health facilities in the Eastern region showed a staff gap of over 40% with inadequate drugs and supplies, poor ANC counselling with essential tests not being done for most of the clients in Eastern Uganda⁴³. Shortage of staff and supplies coupled with poor quality of services could stop pregnant women from utilizing health centres and this could partly explain the finding of our study in Eastern Uganda. Region of residence has also been documented in previous studies as a predictor of ANC access^{25, 26}.

Although working status and level of education were non-significant in the original overall analysis, they were found to be significant with ANC frequency in the sensitivity analysis. Women who were not working were less likely to have four or more ANC visits compared to those who were working. Women who had higher levels of education were more likely to have 4 or more ANC contacts and less likely to initiate ANC in the first trimester compared to those with no education. Working status is closely linked to wealth and level of education as women with higher levels of education tend to be employed and therefore earn income²⁶. Beyond being a source of money to enable ANC access, working and education increase women's exposure and access to information. Working status has also been documented in previous

studies as a positive predictor of ANC access^{25,26}. However some studies have reported mixed results with some showing a negative association where working women were less likely to have a high number of ANC contacts and more likely to initiate ANC late^{27,36}. This is attributed mostly to limited time availability which could also partly explain the observed result of women with higher levels of education being less likely to initiate ANC early.

Strengths and limitations

This is the foremost nationwide analysis that explores association of women empowerment with access to ANC looking at all the three dimensions of access in Uganda, including the latest WHO recommendation of at least 8 ANC contacts. Therefore, it can be used as a yardstick and motivation for further studies on related subject matter. Secondly, we used the most current nationally representative data hence the findings are generalizable to all women in Uganda. However, use of cross-sectional data only enables associations to be established but not causal relationships. Having information regarding the most recent birth, hindered us from getting estimates for each calendar year. The absence of some crucial variables such as distance to the nearby facility was a limitation in the data. Lastly, the possibility of recall bias due to self-reported answers could be a limitation in this study.

Conclusion

This study showed that less than a quarter of women are able to have 4 or more ANC contacts, initiate ANC contacts early and are seen by a skilled ANC provider. The observed insufficient frequency and timing gaps risks women getting less adequate ANC which coupled by the documented low quality of services could explain the slow reductions in maternal mortality levels. However, majority of the women (over 99%) are seen by a skilled provider at least once during their pregnancy. Although ANC frequency (both 4 or more and 8 or more contacts) increased from 2011 to 2016, utilization of 8 or more ANC contacts is still very low at 1.9%. Women empowerment indices which including exposure to mass media and economic empowerment had a positive association with optimal access to ANC. Other socio-economic variables such as age, wealth index, region, level of education and working status were also significantly associated with access to ANC. To ensure that the 2016 WHO ANC guidelines that recommend eight 'contacts' instead of four 'visits' are effectively implemented and achieved, policy-makers and other stakeholders should prioritize use of mass media in maternal health programs, equitable allocation of the limited financial resources with a focus on older, poor and uneducated women. There is need for further studies to look at the quality of ANC and a deep analysis on the association of decision making and access to ANC.

Abbreviations

AOR Adjusted Odds Ratio

CI Confidence Interval

COR	Crude Odds Ratio
DHS	Demographic Health Survey
UDHS	Uganda Demographic Health Survey
OR	Odds Ratio
SD	Standard Deviation
WHO	World Health Organization
SPSS	Statistical Package for Social Science
USAID	United States Agency for International Development.

Declarations

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Availability of data and materials

The data set used is openly available upon permission from MEASURE DHS website (URL: <https://www.dhsprogram.com/data/available-datasets.cfm>).

Authors' contributions

QS Conceived the idea, drafted the manuscript, performed analysis and interpreted the results. RM and JK participated in conceiving the idea and helped in results interpretation and writing. All authors read and approved the final manuscript.

Ethics approval and consent to participate

High international ethical standards are ensured for MEASURE DHS surveys as ethical approval from the country is obtained from a national ethical review board (Uganda National Council for Science and Technology) and local authorities before implementing the survey and well-informed verbal consent is sought from the respondents prior to data collection ^{11,44}. All methods of data collection were performed in accordance with the relevant guidelines and regulations. This data set was obtained from the MEASURE DHS website (URL: <https://www.dhsprogram.com/data/available-datasets.cfm>) after getting

their permission and no formal ethical clearance was obtained since we conducted secondary analysis of publicly available data.

Consent for publication

Not applicable.

Competing interests

All authors declare that they have no competing interests

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