

Interrelationships Between Maternal Health Services in Uganda: A Structural Equation Analysis

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Research article

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Abstract

Background Maternal health care and treatment services have a bearing on maternal mortality. Direct and Indirect factors affecting Maternal health outcomes therefore require understanding to enable well targeted interventions. This study, therefore, assessed the interrelationships between early antenatal care, health facility delivery and early postnatal care.

Methods We investigated Maternal Health services using utilizing Antenatal care (ANC) within three months of pregnancy, Health facility delivery and utilizing postnatal care (PNC) within 48 hours after childbirth. The 2016 Uganda Demographic and Health Survey data was used. During analysis, a Generalized Structural Equation Model using logistic link and binomial family option was used. The interrelated (Endogenous) outcomes were timely ANC, health facility delivery and timely PNC.

Results Timely ANC ($aOR=1.04$; 95% CI=0.95-1.14) and($aOR=1.1$; 95% CI=1.00-1.26) was directly related to increased odds of health facility delivery and timely PNC respectively. Factors that increased the odds of timely ANC as a mediating factor for health facility delivery and timely PNC were women age 35-39 ($aOR=1.18$; 95% CI=0.99-1.24) compared to women age 15-19, completing primary seven ($aOR=1.68$; 95% CI=1.58-1.81) compared to some primary, available health workers ($aOR=1.06$; 95% CI=0.97-1.18), complications ($aOR=2.04$; 95% CI=1.89-2.26) and desire for pregnancy($aOR=1.15$; 95% CI=1.03-1.36). Factors that reduced the odds of timely ANC were being married ($aOR=0.93$; 95% CI=0.89-1.20), distance and cost of service being problematic ($aOR=0.97$; 95% CI=0.85-1.1) ($aOR=0.5$; 95% CI=0.37-0.82) respectively. Factors that significantly influenced health facility delivery through timely ANC were; unmarried ($OR=1.03$; ($=1.04*0.99$)), distance being problematic (($aOR=1.0$; ($=1.04*0.97$)) and complications ($aOR=2.02$; ($=1.04*1.94$))). Factors that significantly influenced timely PNC through timely ANC were; women age 35-39 ($aOR=1.3$; ($=1.18*1.1$)) compared to 15-19, completing primary seven ($aOR=1.68$; ($=1.68*1.1$)))compared to some primary and service cost being problematic ($aOR=0.55$; ($=0.5*1.1$))). Surprisingly, health facility delivery was not statistically significant as a mediator for timely PNC.

Conclusion Attending antenatal care within first trimester was a mediating factor for health facility delivery and early postnatal care. Interventions in maternal health should focus on factors that increase antenatal care first trimester attendance in resource limited settings. Furthermore, Government should reduce on costs of attaining all maternal health services and emphasize girl education completion.

Background

Maternal health is the health of women during [pregnancy](#), [childbirth](#), and the postpartum period. Maternal [health care](#) comprises dimensions of antenatal/prenatal, childbirth delivery/intranatal, [postnatal](#) and neonatal care in order to reduce maternal morbidity and mortality ([1-4](#)). Comprehensive antenatal care (ANC) is defined as monthly visits during the first two [trimesters](#) (from week 1–28), fortnight visits from 28th week to 36th week of pregnancy and weekly visits after 36th week until delivery (delivery at week 38–42) at a health facility; the first ANC visit within the first trimester ([2, 5, 6](#)). Furthermore, postnatal care is a personalized care given to a woman 1 hour after the delivery of the placenta and continuing until 42 days after delivery, the critical period being within 48 hours([7-11](#)).

Though many studies have focused on factors affecting maternal health utilization ([5, 12–15](#)), they addressed the three aspects independent of each other. Without a clear understanding of the interrelationships of these aspects to capture both direct and indirect predictors, these studies fail to address the broader picture of how antenatal care first trimester attendance, health facility delivery and postnatal care 48 hours attendance are interrelated for better mother and baby outcomes.

Motherhood for many women in sub-Saharan Africa is associated with suffering, ill-health and death ([16](#)) The findings by the WHO, UNICEF and UNFPA, show that a woman living in sub-Saharan Africa has 1 out of 6 chances of dying in pregnancy, childbirth and/or after delivery([2](#)). According to AbouZahr ([17](#)) Wild, Chambers ([18](#)) the major factors which prevent women in developing countries from timely accessing maternal health care include distance from the health facilities, cost of receiving the service, parity, after birth practices, inadequate drugs and supplies, multiple demands on women's time, lack of power in decision making within the family and poor quality of services including poor handling by health providers. Furthermore obstacles to timely diagnosis and treatment include suspicion or ignorance of modern health services, long queues at health facilities, inadequate moral and emotional support from husbands and weak incentives to use public health facilities leading to absenteeism of health workers([19](#)).

The Uganda National Population Policy and National Safe Motherhood program (SMP) sought to increase maternal health by promoting informed choice, timely accessibility, equitable and improved quality of Maternal and Infant Health Care, strategic partnerships between government and communities, interventions to forecast high-risk obstetric events and strengthen referral systems ([12, 14, 20, 21](#)). In addition, WHO and MOH earmarked the recommended the frequency and timing for the first ANC and the number of ANC visits increased strategies for a comprehensive and basic Emergency Obstetric Care (EMOC) services, availed skilled health workers, and increased focused antenatal care including Prevention of Mother to Child Transmission of HIV in Uganda([4, 22, 23](#))

Despite the fact that governments has prioritized measures for improvement of maternal health equitably, some women do not deliver at health facility and utilize antenatal and post natal care services late, evidenced by varying times of accessibility and proportion of women who deliver from the health facility([1, 12, 14, 24–26](#)). The survey results showed that the median gestational age when women make their first antenatal visit is approximately 4.7 months, 26 Percent of mothers did not deliver from a health facility and 46 percent of mothers did not receive any postnatal checkup 2 days after birth([1](#))

Mothers who seek for maternal health services during early pregnancy, at birth and after birth have reduced chances for maternal and infant morbidity or deaths ([12, 27, 28](#)). The recommended minimum number of antenatal care visits per pregnancy is at least four times, the first being in the first trimester([5, 29](#)).

Women are encouraged to deliver from a health facility and get postnatal care immediately after delivery within 48 hours, the critical period for both mother and baby(16, 26)

This study provides evidence of the interconnectedness and thus gives a broader understanding of the predictors associated with place of delivery and timely access to antenatal and postnatal care services in Uganda.

Methods

Data source

The 2016 Uganda Demographic and Health Survey (UDHS) data was used for this study. As part of the requirements, authors submitted a proposal to DHS Program/ICF International and permission was granted to download and use data for the study. This data is from a nationally representative sample of households obtained at two- stage cluster sampling (UBOS and ICF International, 2012). The first stage involved the selection of cluster sample; this was followed by selection of households. For all the years, the woman's questionnaire collected information from all eligible women aged 15-49 years. These women were asked questions about their demographic and household characteristics, maternal and child health indicators, prenatal, place of delivery and postnatal, key indicators that best fit in population studies (UBOS, 2017).

Sample size and selection of study participants

The target population included all women of reproductive age 15-49 years. The sample of interest for this study was 10,152 women who had a live birth in the 5 years preceding the survey.

Study variables

In this study, there were three simultaneous equations having at least one endogenous as independent variables in each of the equations. The three interrelated study outcomes (endogenous) variables were antenatal care first trimester attendance, Health facility delivery and postnatal care forty eight hours attendance. On the other hand, the exogenous variables were enabling, predisposing and need factors like maternal education, marital status, age at last birth, parity, complication during pregnancy, desire for pregnancy, exposure to mass media, readily available community health workers, cost of services and distance to health facility.

Data analysis

We analyzed data using STATA 13.0 in three stages. Firstly, we did a descriptive summary of all endogenous variables and other selected variables. Secondly, we performed a bivariate analysis using *ulogit* STATA command in order to attain the likelihood of the predictors of timely ANC, health facility delivery and timely PNC. Thirdly, we used a generalized structural equation modeling with binomial logistic link function since the study had more than one endogenous variable(30, 31). Only variables that had a relatively small probability value of 0.1 or less were considered for inclusion in the multivariate analysis. We used a pairwise correlation matrix to determine the correlation between the independent variables and likelihood ratio test for model goodness of fit.

Results

Description of study participants

Table1 presents the description of 10,152 mothers who had a live birth 5 years preceding the survey. A small proportion of women reported receiving first ANC within the first trimester (28.53%) and at least 7 out of 10 of the women delivered from a healthy facility. Though Uganda demonstrated a decline in maternal mortality and 97% of Ugandan women received antenatal care from a skilled provider, results showed that at most 3 out of 10 women accessed their first ANC within their 3 months of pregnancy. Mothers who received postnatal care checkup within 48 hours were more than those who received after 48 hours (54% and 46% respectively).

Table1 Distribution of women by endogenous variables

Endogenous factors		Percent (%)
Timely access to Antenatal care	n=10,152	
Went within the first trimester	2897	28.53
Went after the first trimester	7255	71.47
Place of delivery		7512
Delivered from a healthy facility	2640	74.00
Did not deliver from a healthy facility		26.00
Timely access to Postnatal care	n=5,901 (recent births in the past 2 years)	
Received PNC checkup within 2days	3186	54.00
Did not received PNC within 2 days	2715	46.00

Results in Table2 indicated that, more women (73.88%) were aged below 35 years. More than 5 out of 10 women had completed primary seven (56.6%) though very few women had completed secondary six (7.1%). A good proportion of women were unmarried (68.59%). Women from a poor background were almost equal to those from the rich background (40.66%) and (40.51%) respectively, and women from an average background were the fewest (18.83%). Six in every ten women (61.02%) didn't point out distance to health facility as a big problem. There was a slight difference between women who thought cost of service was a big problem compared to those who thought it was not a big problem (46.92%) and (53.08%) respectively. Furthermore, results indicated that most health workers were readily available in the community (71.5%), and most women were exposed to atleast one form of media (79.89%). Results in Table2 further indicated that atleast six in every ten women wanted the pregnancy and a small proportion of women had complicated pregnancy (considered those who had a c-section) (6.5%). Finally, results showed an average of 3 children ever born from sampled women with a standard deviation of 3 children.

Table 2: Distribution of women by exogenous factors

Characteristic	n= 10,152	Percent (%)	Cumulative percent
Age			
15-19	2347	23.11	23.11
20-24	2075	20.44	43.54
25-29	1653	16.29	59.83
30-34	1426	14.05	73.88
35-39	1112	10.96	84.84
40-44	889	8.760	93.60
45-49	650	6.400	100.00
Highest Maternal education level			
Some Primary			
Completed primary seven	4406	43.40	43.40
Some secondary	1827	18.00	61.40
Completed secondary six	3198	31.50	92.90
	721	7.100	100.00
Marital status			
Married	3189	31.41	-
Unmarried	6963	68.59	-
Wealth quintile			
Poor	4128	40.66	40.66
Middle	1912	18.83	59.49
Rich	4112	40.51	100.00
Distance to health facility			
Big problem	3957	38.98	-
Not big problem	6195	61.02	-
Cost of service			
Big problem	4763	46.92	-
Not big problem	5389	53.08	-
Availability of a health worker in community			
Readily available			
Not readily available	7258	71.5	-
	2894	28.5	-
Exposure to media			
Exposed to media	8110	79.89	-
Not exposed to media	2042	20.11	-
Pregnancy wanted			
Yes	6185	60.93	-
No	3967	39.07	-
Complicated pregnancy			
Yes	660	6.50	-
No	9492	93.50	-
Parity	Average 3.13	standard deviation 2.98	Min 0 Max 18

Bivariate results

At this stage of analysis, the effect of each independent variable on timely access to ANC services, place of delivery and timely access to PNC services was analyzed individually. A variable with a relative impact ($p < 0.1$) on an outcome was further utilized in the multivariate stage of analysis. Table3 displays the effects of predictor variables on Timely ANC, Health facility delivery and Timely PNC.

Table 3: Differentials in Timely access to ANC, health facility delivery and Timely access to PNC services and their respective predictors

Factor	Unadjusted OR(95% CI)	
	Timely access to ANC	Place of delivery
Place of delivery		
Did not deliver from health facility	-	-
Delivered from health facility	-	-
Timely access to ANC		
Went after the first trimester	-	1.002(0.94-1.13)*
Went within the first trimester	-	1.043(0.95-1.14)*
Age		
19	0.843(0.79-0.97)* 0.980(0.88-1.02)	1.231(1.10-1.43)* 0.760(0.68-0.87)
20	0.765(0.65-0.98)	0.873(0.78-0.97)*
24	0.993(0.87-1.13)	0.902(0.89-1.00)
25	1.200(0.99-1.24)*	1.002(0.92-1.10)*
29	1.000(0.95-1.16)	1.567(1.32-2.01)*
34	0.970(0.88-1.02)	1.320(1.12-1.65)
35		
39		
40		
44		
45		
49		
Highest Maternal education level		
Some primary	1.321(1.01-1.46)	1.523(1.31-1.76)*
Completed primary seven	1.687(1.48-1.82)*	2.472(2.29-2.68)*
Some secondary	0.790(0.63-0.98)*	2.198(1.87-2.58)*
Completed secondary six	1.126(0.83-1.51)	3.454(2.68-4.45)*
Marital status		
Un married	0.845(0.75-0.98)* 0.990(0.85-1.09)*	1.752(1.53-1.90) 0.960(0.89-1.05)
Married		
Wealth quintile		
Poor	0.932(0.87-1.007)	1.004(0.89-1.18)
Middle	0.857(0.71-1.029)	1.119(0.99-1.26)
Rich	0.863(0.737-1.01)	1.665(1.50-1.84)*
Distance to health facility		
Not big problem	1.512(1.23-1.65)* 0.974(0.89-1.13)*	1.231(1.17-1.23) 0.804(0.74-0.88)
Big problem		
Cost of service		
Not big problem	1.031(0.98-1.14)* 0.605(0.47-0.82)*	0.865(0.76-0.89) 0.901(0.86-0.97)
Big problem		
Availability of a health worker in community		
Not readily available	1.021(0.95-1.17)* 1.061(0.97-1.18)*	1.034(0.98-1.12)* 2.012(1.98-2.56)*
Readily available		
Exposure to media		
Not exposed to media	0.923(0.87-1.10)	1.002(0.97-1.23)*
Exposed to media	1.077(0.92-1.25)	1.269(1.14-1.41)
Pregnancy wanted		
No	0.823(0.76-0.98)*	0.872(0.78-0.98)
Yes	1.170(1.03-1.36)*	0.961(0.88-1.04)
Complicated pregnancy		
No		0.621(0.54-
Yes	0.87)* 1.942(1.73-2.36)*	1.021(0.98-1.23) 2.068(1.97-2.27)*
Parity	0.942(0.91-0.96)*	0.965(0.95-0.98)*

Note: (OR): Exponential coefficients; CI: confidence intervals; * indicates variables with $p<0.1$ and (-) indicates variables not considered for a particular outcome

Factors associated with relatively increased odds of timely access to ANC were women aged 35-39 years, completing primary seven, distance to health and cost of service not being a big problem, readily available health worker in a community compared to when a health worker is not readily available, women's desire for pregnancy and having a complicated pregnancy ($p<0.1$). Those with relatively reduced odds were women aged 15-19 years, not completing secondary, being married compared to unmarried, distance to healthy facility and cost of service being a big problem, women who didn't want the pregnancy and parity ($p<0.1$).

The factors associated with relatively increased odds of a woman delivering from a health facility were having accessed ANC within three months of pregnancy compared to those attained ANC after first trimester, women of age 15-19 and 40-44 years compared to those of age 35-39 years, completing primary seven, having some secondary and completing secondary six compared to incomplete primary, belonging to a rich wealth quintile, readily health workers in community as compared to not being readily available, not being exposed to media and finally, having a complicated pregnancy ($p<0.1$). The factors associated with reduced odds of health facility delivery included, women of age 25-29 years, and parity ($p<0.1$).

The factors that were associated with relative increased odds of timely access to PNC were women who received ANC within the first trimester, women age 45-49 and 15-19 as compared to those age 30-34 years, women who had some secondary, distance to health facility not being a problem, having a readily available health worker in a community and women having had a complicated pregnancy ($p<0.1$). The factors associated with relatively lowered odds of timely access to PNC were receiving ANC after the first trimester, being in the poor wealth quintile, distance to health facility being a big problem, having no readily available community health worker, not being exposed to media and parity ($p<0.1$)

Multivariate level

Table 4 indicates the details of the interrelationship between antenatal care first trimester attendance, health facility delivery and postnatal care 48 hours attendance. The direct predictors of timely ANC as a moderating factor of health facility delivery and timely PNC were women of age 35-39, completing primary seven, being married, distance and cost of service being problematic, pregnancy wanted, complications and parity. The direct predictors of health facility delivery were antenatal within first trimester attendance, women of age 25-29, 35-39 and 40-44 years, maternal education, cost of service, community health worker, media and parity. Direct factors for timely PNC were antenatal within first trimester attendance, women of age 40-49, having some secondary, rich wealth quintile, distance, community health worker, complicated pregnancy and parity.

Table 4: Interrelationships between health facility delivery, Timely access to ANC and PNC services and their respective predictors

		aOR(95% CI)
Place of delivery	Timely access to ANC	Place of delivery
Did not deliver from health facility	-	-
Delivered from health facility	-	-
Timely access to ANC		
Went after the first trimester	-	1.0
Went within the first trimester	-	1.04(0.95-1.14)*
Age		
15-19	1.0	1.0
20-24	0.92(0.82-1.00)	0.72(0.68-0.87)
25-29	0.75(0.65-0.98)	0.83(0.78-0.97)*
30-34	0.96(0.87-1.13)	0.82(0.79-1.00)
35-39	1.18(0.99-1.24)*	1.00(0.92-1.10)*
40-44	0.98(0.95-1.16)	1.52(1.32-2.01)*
45-49	0.91(0.88-1.00)	1.30(1.18-1.65)
Highest Maternal education level		
Some primary	1.0	1.0
Completed primary seven	1.68(1.58-1.81)*	1.47(1.29-1.68)*
Some secondary	0.9(0.63-0.98)	2.20(1.87-2.58)*
Completed secondary six	1.12(0.83-1.51)	3.58(2.68-4.44)*
Marital status		
Un married	1.0	1.0
Married	0.93(0.89-1.20)*	1.01(0.99-1.25)
Wealth quintile		
Poor	-	1.0
Middle	-	1.21(0.99-1.26)
Rich	-	1.66(1.50-1.84)
Distance to health facility		
Not big problem	1.0	1.0
Big problem	0.97(0.85-1.10)*	0.80(0.74-0.87)
Cost of service		
Not big problem	1.0	1.0
Big problem	0.50(0.37-0.82)*	0.90(0.86-0.97)*
Availability of a health worker in community		
Not readily available	1.0	1.0
Readily available	1.06(0.97-1.18)*	2.05(1.98-2.56)*
Exposure to media		
Not exposed to media	-	1.0
Exposed to media	-	1.26(1.14-1.40)*
Pregnancy wanted		
No	1.0	-
Yes	1.15(1.03-1.36)*	-
Complicated pregnancy		
No	1.0	1.0
Yes	2.04(1.89-2.26)*	2.06(1.97-2.27)
Parity	0.89(0.81-0.92)*	0.92(0.86-0.98)*

Note: (OR): Exponential coefficients; CI: confidence intervals; * indicates significant effects with $p<0.05$ and (-) indicates variables not considered for a particular outcome

Timely access to ANC had a significant impact on place of delivery and timely access to PNC ($p<0.05$). This implies that predictors of timely access to ANC have an indirect effect on place of delivery and timely access to PNC, the main aim of this study. Table 5 displays the results

Table 5: Indirect effects affecting health facility delivery and postnatal care within 2 days

Exogenous variables	Health facility delivery through timely ANC (coefficients at 95% CI)	PNC attainment within 2 days through timely ANC (coefficients at 95% CI)
Age		
15-19	-	1.0
20-24	-	-
25-29	-	-
30-34	-	-
35-39	-	(1.18*1.1)=1.3*
40-44	-	-
45-49	-	-
Maternal education level		
Some primary		
Completed primary 7	-	1.0
Some secondary	-	(1.68*1.1)=1.85*
Completed secondary 6	-	-
Marital status		
Unmarried	1.0	-
Married	(1.04*0.99)=1.03*	-
Distance to health facility		
Not big problem		
Big problem	1.0 (1.04*0.97)=1.00*	-
Cost of service		
Not big problem	-	1.0
Big problem	-	(0.5*1.1)=0.55*
Complicated pregnancy		
No		
Yes	1.0 (1.04*1.94)=2.02*	-

Note: * indicates significant effects with $p<0.05$ and (-) indicates variables not considered for a particular outcome

The indirect predictors significantly influencing health facility delivery through antenatal care first trimester attendance were: marital status, distance to the health facility and complicated pregnancy ($p<0.05$). Married women who accessed ANC within the first trimester had a 3% increased odds to deliver from the health facility as compared to married women who accessed ANC after the first trimester ($OR=1.03$, $p=0.000$). The odds to deliver from a health facility for women where distance to health facility was a big problem and had accessed ANC services within first trimester were not significantly different from women where distance to health facility was a big problem and accessed ANC after first trimester ($OR=1.0$, $p=0.035$). Women who had complicated pregnancy and had accessed timely ANC were twice more likely to deliver from a health facility as compared to women who had complications and had accessed first ANC after first trimester ($OR=2.02$, $p=0.000$).

The indirect predictors significantly influencing postnatal 2days attainment through antenatal care first trimester attendance were: maternal age, maternal education and cost of service ($p<0.05$). Women aged 35-39 who accessed ANC within the first trimester had a 30% increased odds of attaining PNC services within 2 days as compared to women aged 35-39 who went for ANC after first trimester ($OR=1.3$). Women where the cost of service was a big problem and accessed ANC services within the first trimester were half as likely to access PNC within 2 days compared to women where the cost of service was a big problem and access ANC after the first trimester ($OR=0.55$). Women who had completed primary seven and had accessed ANC within the first trimester had an 85% increased odds to access PNC services within 2 days after childbirth as compared to women who had completed primary seven and accessed ANC after first trimester ($OR=1.85$).

Figure1 is a causal loop diagram that summarizes the interconnectedness between the maternal health care timely utilization factors.

Discussion

The study has shown interrelationships between timely ANC, health facility delivery and timely PNC. Timely ANC had a statistically significant effect on health facility delivery and timely PNC. Surprisingly, health facility delivery was not statistically significant as a mediator for timely PNC.

Interrelationship between timely ANC, Health facility delivery and timely PNC

The direct determinants that increased odds of timely ANC as a mediating factor for health facility delivery and timely PNC were women age 35-39 compared to women age 15-19, completing primary seven compared to having some primary, having readily community workers, complications and desire for pregnancy. Furthermore, factors that reduced the odds of timely ANC were being married, distance and cost of service being problematic. Factors that significantly influenced health facility delivery through timely ANC were; being unmarried, distance being problematic, and complicated pregnancy. Predictors that significantly influenced timely PNC through timely ANC were women age 35-39 compared to age 15-19, completing primary seven compared to some primary and cost of service being problematic. The study is in agreement with (5, 32-35) where family income, age at delivery, media exposure, attitude towards pregnancy, knowledge about the danger signs of pregnancy, husband's approval of ANC, and distance to health facility were associated with ANC service utilization at any point during pregnancy. Hagey, Rulisa (36) explored social and behavioral factors that affect timely initiation of ANC from the perspective of health care providers in Kigali city and found that women's knowledge gaps; and having previous births were among the main barriers to first ANC initiation.

Although many studies identify direct factors influencing health facility delivery and timely postnatal care(3, 8, 12, 20, 21, 36–40), findings from this study further established predictors that indirectly affect health facility delivery and timely PNC through timely ANC as a mediating variable. Married women who accessed ANC within the first trimester had a 3% increased odds to deliver from the health facility as compared to married women who accessed ANC after the first trimester. The odds to deliver from a health facility for women who had timely ANC and distance to health facility was problematic were not significantly different from the women who accessed ANC after first trimester and distance to health facility was problematic. Women who had complicated pregnancy and had accessed timely ANC were twice more likely to deliver from a health facility as compared to women who had complications and had accessed ANC after first trimester.

Women age 35–39 who accessed ANC within the first trimester had a 30% increased odds of attaining PNC services within 2 days as compared to women age 35–39 who went for ANC after first trimester. Women where the cost of service was a big problem and accessed ANC services within the first trimester were half as likely to access PNC within 2 days compared to women where the cost of service was a big problem and access ANC after the first trimester. Women who had completed primary seven and had accessed ANC within the first trimester had an 85% increased odds to access PNC services within 2 days after childbirth as compared to women who had completed primary seven and accessed ANC after first trimester.

Grigg, Tracy (41) revealed that, confidence develops in women to deliver from a health facility given that they had attained ANC, citing that, women become confident with the midwife, the maternity system as well as the birth process during antenatal attendance. Pell, Meñaca (13) disagreed that, antenatal attendance may discourage delivery in health units if mothers are told that the pregnancy is normal. A study by Machira and Palamuleni (42) revealed that women who obtain timely ANC in Malawi were more likely to utilize public health care childbirth and timely PNC. Furthermore, El Shiekh and van der Kwaak (20) reported that nomads in Sudan who utilize health facility had attained timely and 4+ ANC compared to their counterparts. According to Weissman, Mbonye (22), most mothers from communities where health workers are available like mama ambassadors are more likely to attend ANC within their 3 months of pregnancy, deliver from health facilities and receive PNC within 48 hours after birth the time mothers and newborns are most vulnerable.

Studies currently show that, women literacy rates are lower compared to their male counterparts (67.6 percent and 77.4 percent respectively) and still lower than national level's 72.2 percent and net enrolment rate for women at primary level is 81 percent and 32 percent secondary level(43). Interestingly, this study indicates that having some secondary education increased odds of women utilizing MHCTS. Additionally, child bearing in Uganda starts as early as 13 years (1, 43)when they are supposed to be at school, hence sensitization on use of MHCTS should begin from as early as primary level for better outcomes.

Limitation of the study

The analysis was limited to the available information extracted from UDHS, but weighting the data was done due to the non-proportional allocation of the sample to different regions and to their urban and rural areas, and the possible differences in response rates.

Conclusions

Attending antenatal care within the first trimester was a mediating factor for health facility delivery and Timely postnatal care. Interventions in maternal health should focus on factors that increase early timing of ANC especially in resource limited settings. This study revealed interdependence between the predictors of maternal health care utilization. Therefore, there is need to formulate policies and design maternal health service programs that sensitize and integrate all the MHS and help mothers to seek services early.

The government of Uganda and other stakeholders should reduce on costs of attaining the maternal health services, strengthen community health workers and emphasize girl child education completion, because they will be better positioned to acquire, understand and utilize knowledge when exposed to media on maternal health information.

Lastly, sensitization about maternal health care services should begin at lower education levels since they are more at risk, this study revealed that most interviewed women had primary as their highest level of education.

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Abbreviations

MHCTS Maternal Health Care and Treatment Services

ADB African Development Bank

UBOS Uganda Bureau of Statistics

DHS Demographic Health Survey

ANC Antenatal Care

PNC Postnatal Care

SDG Sustainable Development Goals

GSEM Generalized Structural Equation Model

MUBS Makerere University Business School

Declarations

Competing interests

The authors declare that they have no competing interests.

Author's contributions

RA participated in preparation of this MS; conceived the study, selected data, conducted data analyses, reviewed the scientific content, and interpretation of findings, discussion, and conclusions. LAK participated in conceptualization, Methodology, substantively revised the Manuscript. RW participated in preparing this MS, conceptualization, Methodology, scientific content and MS review. All authors read and approved the final manuscript.

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Figures

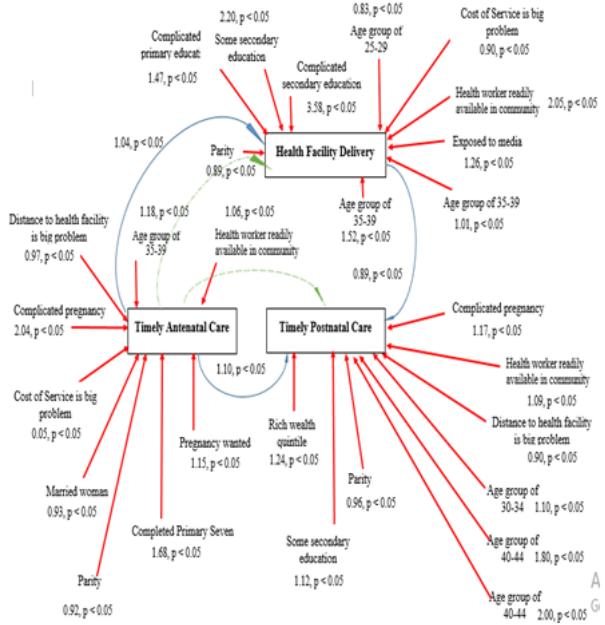


Figure 1

causal loop diagram that summarizes the interconnectedness between the maternal health care timely utilization factors