BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-054136
Article Type:	Original research
Date Submitted by the Author:	03-Jun-2021
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Keywords:	EPIDEMIOLOGY, PUBLIC HEALTH, Community child health < PAEDIATRICS

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Determinants of continued maternal care-seeking during pregnancy, birth and postnatal period and associated neonatal survival outcomes in Kenya and Uganda: analysis of national data.

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Keywords: Care-seeking behaviour, neonatal mortality.

Abstract

Objectives: To examine how maternal and sociodemographic factors determine maternal care-seeking behaviour from pregnancy to postnatal period in Kenya and Uganda and to estimate associated neonatal survival outcomes.

Design: A cross-sectional study using data from Uganda and Kenya Demographic and Health Surveys, 2014-2016, we employed multinomial regression to examine how maternal and sociodemographic factors predict continuity of care-seeking. Associated neonatal survival outcomes were assessed using binary logistic regression.

Setting: Kenya and Uganda

Participants: Mothers aged 15-49 years old who delivered last live-born baby within 1-59 months prior to the commencement of the survey.

Main outcome measure: Care-seeking behaviour and associated neonatal survival outcomes.

Results: Overall, 57% of mothers had 4 or more antenatal care contacts, of which 73% and 41% had facility births and postnatal care, respectively. Parental education was associated with higher uptake of care in over 8 out of 10 care classes; relative risk ratios, RRR ranged from 2.1–8.6 (95% confidence intervals [95% CI] 1.2–16.0). Similarly, exposure to mass media, desire to have a baby and being married were associated with higher care-seeking. However, care-seeking reduced if a husband made maternal care-seeking decisions. Transportation problems and living in rural versus urban were associated with low care utilization, RRR ranged from 0.6 – 0.7 (95% CI 0.5–0.9) and 0.4 – 0.6 (95% CI 0.3–0.8) respectively. The two *lowest* care-seeking categories indicated the highest odds for neonatal mortality, aOR 3.8 (95% CI 1.7–8.6). 22% neonatal deaths were attributable to inadequate maternal care attendance.

Conclusion: Reviews of large-scale studies could enable optimal standard classification for ranking maternal care-seeking behaviours. This in turn can be used by care providers to promptly identify a mother´s care-seeking level on the basis of previous care history or a brief interview and subsequently adopt new strategies to close care-seeking gaps.

Strengths and limitations of this study

- The nationally representativeness of the data and the large sample size of the study allowed for valid stratified analysis with implications for national policy developments to improve neonatal survival outcomes for countries in SSA region.

- Recall bias may not be completely eliminated from the study since the data was collected retrospectively through interviews.

- However, by selecting the most recent births and owing to the fact that childbirth is a special event not easily forgettable, the study findings reflect the reality with considerable validity.

- The study was based on maternal attendance to care and not the actual obstetric care received thus aspects related to lack of drugs and inadequate facilities were not captured in our study.

Introduction

In 2019, close to 7000 newborns worldwide died within their first 28 days of life (neonatal period), as per the United Nations Inter-Agency Group for Child Mortality Estimation,[1]. Roughly three-quarters of these deaths occurred during childbirth and the first week of neonatal period,[1, 2] and the major causes included infections such as sepsis and pneumonia, birth complications and prematurity-related problems such as asphyxia and low birthweight, [3]. Comprehensive antenatal care (ANC), skilled birth attendance and postnatal (afterbirth) care (PNC) have long been recognized as key strategies that profoundly contribute to newborn survival,[4,5]. In 2015, 64% of women globally had 4 or more ANC contacts,[6]. and prevalence of health facility births was 80% in 2019,[7]. In high income countries such as in Sweden where neonatal death rate is among the lowest globally (1.4 deaths per 1000 live births, in 2019), almost all mothers obtain comprehensive ANC, facility births and PNC services,[8]. However, in sub-Sahara African (SSA) and southeast Asian countries where over 70 percent of all neonatal deaths occur [9], utilization of the components of care is relatively low and vary substantially,[10-12].

Accordingly, since 2005, the World Health Organization (WHO) has been advocating for the implementation of continuum of care strategy, a concept that promotes continual access to care from pre-pregnancy to the first few weeks of after childbirth,[13,14]. While several SSA countries including Kenya and Uganda report over 80% coverage of at-least-one ANC contact with skilled provider,[15,16], late initiation of ANC visits, lower health facility births and very low PNC utilization still pose enormous challenges. A Lancet study reported that prevalence of early initiation of ANC contact (<14 weeks gestation) was only 24% in SSA, much lower compared to 85% in high income countries,[17]. The challenge in a number of SSA countries, however, is that despite the removal of user fees for all maternal and child health service in many countries, a number of sociodemographic factors and maternal characteristics still remain critical determinants of care utilization that hinder or motivate choices and preferences in maternal care-seeking,[18].

Andersen and Newman behavioural model of utilization of health care services has widely been used to identify factors that influence care-seeking behaviour,[19]. The model outlines three main factors that interact to predict utilization of care and they included societal, individual and health system determinants,[19]. See diagrammatic details in Supplementary file 1. The model has been employed by studies to examine utilization of the different

components of maternal and newborn care such as ANC,[20,21], childbirth,[22] or PNC,[23]. However, very few studies in SSA have assessed how factors in the Andersen and Newman model modify care-seeking behaviour along the continuum of care from pregnancy to postnatal period, and even much fewer within the context of free maternity policy.

A recent community-based study in Ethiopia showed that women with higher education, married women, and those with autonomy in health care decision were likely to complete continuum of care,[24]. Whereas the study provided critical findings, it considered only 1 ANC visit and not the WHO or Ministry of Health (MoH) recommended number of contacts,[24]. Another similar study by Oh et al. in 2013 in Gambia also found a number of factors associated with maternal care-seeking continuum and early ANC visits,[25]. However, the study lacked PNC estimates for facilities deliveries,[25]. Another sub-nationally study in Tanzania found, among other factors, knowledge or experience of pregnancy danger signs was associated with higher care-seeking,[26]. A 2019 Cochrane review of several qualitative studies found that influence by others, illness-free pregnancy, financial dependence, and selective use of ANC as potential barriers to continual maternal care utilization,[27]. The few existing studies on continuum of care-seeking in SSA are very informative but limited in one way or another, and none to our knowledge examined associated neonatal survival outcomes.

Kenya and Uganda are among the 10 countries in SSA countries with most neonatal deaths,[28], and despite free maternity policy in both countries and relatively higher gross domestic product (GDP) than some countries in the East Africa region such as Rwanda, neonatal mortality rates have declined much more slower compared to Rwanda,[29,30]. Thus, this study aims to examine how sociodemographic and maternal factors influence care-seeking behaviour in the care-seeking continuum from pregnancy, childbirth to postnatal period in Kenya and Uganda. A secondary aim was to estimate the impact of levels of continued maternal care-seeking on neonatal survival.

Methods

Study settings

Kenya and Uganda have closely comparable demographics. The total population in Kenya and Uganda as of 2016-2019 was about 90 million,[31,32]. More than 70 % of the populations live in the rural areas with agriculture as their main source of

livelihood,[31,33,34]. The sex ratio is approximately 1:1,[31,35] and general life expectancy at birth in 2016 was similar in both countries, for females it was 64 and 67 years in Uganda and Kenya, respectively,[36]. Maternal mean age at first childbirth is 19–20 years. Neonatal mortality rates in both countries were about 22 deaths per 1000 live births in 2016,[30]. Like a number of countries in SSA, Kenya and Uganda provide free maternal care services in primary level health facilities,[37].

Data source and study design

We obtained the cross-sectional, population-representative, demographic and health survey (DHS) datasets for Kenya 2014 and Uganda 2016 after a formal request to the DHS secretariat. DHS collects maternal and child health data across the whole country in a two-stage cluster sampling procedure. The DHS uses standard procedures and protocols that ensure complete anonymity of the respondents and adherence to international ethical standards for research. We utilized the data for the most recent live births, 1-59 months prior to the surveys. More details on data collection procedure can be accessed from DHS methodology and manuals,[38,39].

Patient and public involvement

A number of researchers and sexual and reproductive health education colleagues with experiences in low-middle income settings as well as health practitioners in direct working contact with maternity care in Kenya and Uganda were consulted during the design of this study.

Study variables

Outcome variables

Care-seeking continuum was the primary outcome variable. It constituted a combination of the number of ANC visits, health facility birth and at least one PNC contact within 28 days postpartum (after birth). Continuum of care-seeking was categorized into 12 classes on the basis of relative adherence to basic (modified) WHO and MoH recommendations for care from pregnancy to postnatal period prior to 2016, that is, before the current WHO recommendation of 8 ANC visits. Since data for both countries were collected prior to the new WHO 2016 ANC recommendations, we used previous Focused ANC recommendations. A mother with a combination of 4 or more visits, health facility birth (skilled birth) and at least 1 PNC contact was classified in the *highest* category of care-seeking and those with

least/no amount of care were categorized as *lowest* class. The intermediate categories were classified on the basis of optimal and perceived descending-level of care-seeking behaviour as *higher*, *high, moderately high, slightly high, moderately low, moderately lower, very low, strategic-lowest, `unstrategic´-lowest, and 2nd lowest,* as shown in Table 1 below.

Table 1: Classification of continuum of care-seeking classes during antenatal period, childbirth and within 28 days postnatal period in Kenya and Uganda.

	≥ 4 ANC visits	**2-3 ANC visits**	**1 ANC visit and 1st contact in 3rd trimester**	**1 ANC visit and 1st contact in 1st or 2nd trimester**	**0 ANC visit**
Health facility birth					
PNC - Yes	Highest	Higher	`Strategic´- lowest	`Unstrategic´- lowest	2nd lowest
PNC - No	High	Moderate high			
Birth outside of health facility					
PNC - Yes	Slightly high	Moderately lower			Lowest
PNC - No	Moderately low	Very low			
ANC – Antenatal care, PNC – Postnatal care, 1st – first, 2nd - Second					

The first component of classification was in accordance with the number of ANC visits a mother had, the second level was on the basis of whether or not a mother delivered at the health facility and the last part of continuum of care was whether or not a mother had PNC visit. For those who had only 1 ANC visit, further divisions were made to account for timing of the visit, either first/second trimester or in the third trimester (last 3 months of pregnancy).

Neonatal mortality was a secondary outcome variable that was dichotomized into *`yes´* (died) and *`no´* (lived) depending on whether the neonate lived or not. The predictor variables for this outcome variable were the modified classes of care-seeking continuum discussed as the primary outcomes above.

Independent variables

These constituted sociodemographic factors and maternal characteristics that were examined across all care-seeking continuum categories of the primary outcome variable. They included variables that the modified Andersen and Newman behavioural model for care utilization identified as predictors of care-seeking behaviour,[19]. Further, the categorization of these variables was also informed by a number of maternal and child health studies previously conducted in SSA. They included *maternal age* and *place of residence* that were categorized

into 15–24, 25–34 and 35–49 years, and rural or urban respectively,[40]. *Marital status* was dichotomized into single or married,[41]. A mother having a *problem with longer distance/transportation to nearest health facility* was classified as `yes´ if it was a problem and `no´ if it was not,[42]. *Desire to have a newborn child, whether or not mother was told about pregnancy complications,*[43] and *having exposure to mass media,*[44] were all categorized *as ´yes´ and ´no´*. The variable *who ultimately makes maternal care-seeking decisions* was categorized as respondent (woman) alone, husband alone or joint decision,[45]. *Education* was categorized as no education, primary education and secondary or higher,[46]. *Parity* (number of children ever born) was categorized as primiparity (for first time mothers) para 2-3 (for those with 2-3 children) and para 4+,[40]. *Wealth status* was classified into poor (poor/poorest), middle and rich(rich/richest),[46,47]. The wealth status in DHS is indexed based on household cumulative living standards taking into account assets possessed, water and sanitation facilities. Place of residence was classified into rural and urban,[47].

Mapping the predictor – outcome relationship using directed acyclic graphs

Prior to the analysis, the directed acyclic graphs (DAGs) by Textor and colleagues,[48] were used to map the predictors of both care-seeking behaviours and neonatal mortality on the basis of existing peer-reviewed evidence and to identify any confounding bias in our models. Supplementary file 2, Diagrams 1.a and b illustrate the process. For Diagram 1.b, the lower levels of care-seeking are represented by a lack of a care component(s) that is/are major non-causal risk factor for neonatal mortality.

Data analysis

We used cross-tabulations to examine the distribution of mothers across variables and variable categories in the different levels of care-seeking continuum. We also investigated correlations between ANC visits and proportions of health facility childbirths and PNC visits. Multinomial logistic regression models examined the associations between sociodemographic and maternal factors and continued care-seeking at different care-seeking classes/categories, with the *lowest* class as the reference group.

Binary logistic regression was used to determine the odds ratios for the associations between the various classes of care-seeking continuum and neonatal mortality, with the *highest* class as the reference group. Further, the resulting significant adjusted odds ratios were then used to estimated attributable risk fraction (AR) and population attributable risk fraction (PAR) to

determine proportion of neonatal deaths that would be prevented if mothers in a given lower level of care-seeking continuum had sought care at the *highest* class. For plausible analysis, owing to fewer numbers in certain neonatal mortality strata, certain classes with closer characterization were merged together. The *slightly high* class was merged with *moderately low,* and *very low* was combined with *moderately low.* Similarly *strategic* - and `*unstrategic*´ - *lowest classes* were also joined together. These resulted into 9 categories that were used in the binary logistic regression model to investigate the associations between different classes of care-seeking continuum and neonatal mortality. We used Stata version 16 (College Station, TX: Stata Press) and Microsoft Excel for analysis and to generate graphical summaries of results. Sampling weights were applied, and we accounted for complex sampling design recommended by the DHS methodology guide.

Estimating attributable neonatal mortality risk proportions associated with low levels of care-seeking continuum.

The attributable risk proportions and population attributable neonatal mortality risk proportion (PAR) were obtain by the formulas AR = $[(OR-1)/OR)] * 100$ and PAR = Pe * $[(OR-1)/OR)] * 100$ respectively, where OR is the statistically significant adjusted odds ratio associated with that care-seeking class and *Pe* is the proportion of the total mortalities in that given care-seeking class.

Results

Table 2 and Figure 1 indicate that over 95% of mothers had at least 1 ANC visit and about 56% had 4 or more ANC contacts in Kenya and Uganda. Of those who had 4 or more ANC visits, 73% gave birth at a health facility and about 41% had newborn PNC check-up within 28 days after birth as shown in Table 2.

Table 2: Distribution of mothers by continuum of care-seeking classes during antenatal period, childbirth and within 28 days postnatal in Kenya and Uganda, using demographic and health survey 2014-2016 data.

	≥ 4ANC visits, n=13888	**2-3 ANC visits, n=8744**	**1 ANC visit and 1st contact in 3rd trimester n=533**	**1 ANC visit and 1st contact in 1st or 2nd trimester n=240**	**0 ANC visit, n=1095**
Health facility birth (%)					
PNC - Yes	4961(35.7)	2355(26.9)	76(14.2)	39(16.3)	68(6.2)

PNC - No	5179(37.3)	2782(31.8)	133(25.0)	80(33.3)	106(9.6)
Birth outside health facility					
PNC - Yes	752(5.4)	632(7.2)	56(10.5)	7(2.9)	121(11.1)
PNC - No	2996(21.6)	2975(34.0)	268(50.3)	114(47.5)	800(73.1)

The scatter plot in Figure 2 shows a positive correlation between number of antenatal care visits and both proportions of facility births and PNC visits. Further, Figure 3 shows that a

single early ANC visit in the 1st or 2nd trimester increased the likelihood of health facility childbirth as opposed to late ANC visit in the 3rd trimester.

Table 3 shows the distribution of maternal and sociodemographic characteristics by care-seeking behaviour from pregnancy to postnatal period. Majority (≥ 39%) of the mothers were between 25–34 years of age in all care-seeking categories. Overall, 70% of the mothers lived in a rural setting and 37 % of all women had problems with distance to the nearest health facility. Roughly 30 % and 55% of those who had highest and lowest care-seeking tendencies respectively, indicated distance as a hindrance to care-seeking. Half of all the mothers had primary education. About 40% of highest care-seekers had secondary or higher education while 59% of lowest care-seekers had no formal education. Similar trends were observed among their husbands/partners.

Table 3. Distribution of maternal and sociodemographic factors, by continuum of care-seeking classes combining antenatal care (ANC) visits, delivery and postnatal care (PNC) in Kenya and Uganda, using demographic and health survey 2014-2016 data.

	4 or more ANC visits, n=13888				**2-3 ANC visits, n=8744**				**1 ANC visit in 3rd trimester, n=533**	**1 ANC visit, in 1st or 2nd trimester, n=240**	**0 ANC visit, n=1095**	
Maternal & sociodemographic characteristi-cs	**Highest** *(Health facility birth & PNC). n*(%)	**High** (*Health facility birth, no PNC). n*(%)	**Slightly high** (*No health facility birth, PNC). n*(%)	**Mod-low** *(No health facility birth, no PNC).* n(%)	**Higher** *(Health facility delivery, PNC). n(%)*	**Mod- high** *(Health facility birth, no PNC). n*(%)	**Mod-lower** *(No health facility birth, PNC). n*(%)	**Very low** *(No health facility birth, no PNC). n* (%)	**Strategic-lowest** *([a]Some facility births and [b]some PNC).* n(%)	**`Unstrategic´-lowest** *([c]Some facility births and [d]some PNC). n* (%)	**2nd lowest** *(Health facility birth, [e]some PNC). n*(%)	**Lowest** (*No health facility births, [f]some PNC)* n(%)
Maternal age (Years)												
15-24	1625(32.8)	1680(32.4)	213(28.3)	815(27.2)	832(35.3)	1001(36.0)	159(25.2)	778(26.2)	189(34.9	86(34.8)	75(42.6)	227(24.5)
25-34	2406(48.5)	2513(48.5)	315(46.6)	1410(47.1)	1064(45.2)	1240(44.6)	303(47.9)	1385(46.6)	211(39.0)	100(40.5)	62(35.2)	417(44.9)
35-49	930(18.7)	986(19.1)	189(25.1)	771(25.7)	459(19.5)	541(19.4)	170(26.9)	812(27.3)	141(26.1)	61(24.7)	39(22.2)	284(30.6)
Place of residence												
Urban	1669(33.6)	2096(40.5)	164(21.8)	483(16.1)	677(28.8)	956(34.4)	122(19.3)	409(13.8)	122(22.6)	57(23.1)	54(30.7)	105(11.3)
Rural	3292(66.4)	3083(59.5)	588(78.2)	2513(83.9)	1678(71.3)	1826(65.6)	510(80.7)	2566(86.2)	419(77.4)	190(76.9)	122(69.3)	823(88.7)
Distance to nearest health facility is a problem												
No	3490(70.3)	1561(66.5)	472(62.8)	876(52.3)	1580(67.1)	810(62.9)	379(60.1)	862(50.5)	192(58.9)	85(50.9)	80(66.7)	211(44.5)
Yes *(A big problem)*	1471(29.7)	785(33.5)	280(37.2)	798(47.7)	775(32.9)	477(37.1)	252(39.9)	844(49.5)	134(41.1)	82(49.1)	40(33.3)	263(55.5)

Some – a proportion within that specific category: [a]39%, [b]25%, [c]50%, [d]19%, [e]39%, [f]13%. 1st – first, 2nd – second, Mod – Moderately

	4 or more ANC visits, n=13888				2-3 ANC visits, n=8744				1 ANC visit in 3rd trimester, n=533	1 ANC visit, in 1st or 2nd trimester, n=240	0 ANC visit, n=1095	
Maternal & sociodemographic characteristi-cs	**Highest** *(Health facility birth & PNC). n*(%)	**High** (*Health facility birth, no PNC). n*(%)	**Slightly high** (*No health facility birth, PNC). n*(%)	**Mod-low** *(No health facility birth, no PNC).* n(%)	**Higher** *(Health facility delivery, PNC). n(%)*	**Mod- high** *(Health facility birth, no PNC). n*(%)	**Mod-lower** *(No health facility birth, PNC). n*(%)	**Very low** *(No health facility birth, no PNC). n* (%)	**Strategic-lowest** *([a]Some facility births and [b]some PNC).* n(%)	**`Unstrategic´-lowest** *([c]Some facility births and [d]some PNC). n* (%)	**2nd lowest** *(Health facility birth, [e]some PNC). n*(%)	**Lowest** (*No health facility births, [f]some PNC)* n(%)
Maternal education level												
No education	435(8.8)	389(7.5)	167(22.2)	811(27.1)	241(10.2)	271(9.8)	140(22.2)	726(24.4)	123(22.7)	94(38.1)	33(18.8)	551(59.4)
Primary	2535(51.1)	2721(52.5)	486(64.6)	1789(59.7)	1369(58.2)	1645(59.1)	399(63.1)	1960(65.9)	332(61.4)	127(51.4)	99(56.3)	336(36.2)
Secondary & higher	1991(40.1)	2069(40.0)	99(13.2)	396(13.2)	745(31.6)	866(31.1)	93(14.7)	289(9.7)	86(15.9)	26(10.5)	44(25.0)	41(4.4)
Partner/husband education level												
No education	255(6.1)	128(6.5)	118(16.9)	276(19.1)	142(7.4)	68(6.5)	98(16.8)	259(17.5)	45(17.3)	33(25.4)	14(18.7)	228(54.2)
Primary	1860(44.6)	991(50.3)	401(57.5)	815(56.5)	1011(52.4)	590(56.2)	348(59.8)	938(63.5)	149(57.3)	69(53.1)	44(58.7)	154(36.6)
Secondary & higher	2059(49.3)	851(43.2)	179(25.6)	352(24.4)	777(40.2)	392(37.3)	136(23.4)	280(19.0)	66(25.4)	28(21.5)	17(22.7)	39(9.3)
Knowledge about pregnancy, birth complications (only Kenya)												
No	537(32.8)	319(39.1)	348(47.4)	286(63.4)	341(45.6)	250(53.7)	349(55.6)	351(66.9)	127(71.4)	41(55.4)	--	--
Yes	1099(67.2)	496(60.9)	386(52.6)	165(36.6)	407(54.4)	216(46.3)	279(44.4)	174(33.1)	51(28.6)	33(44.6)	--	--

	4 or more ANC visits, n=13888				2-3 ANC visits, n=8744				1 ANC visit in 3rd trimester, n=533	1 ANC visit, in 1st or 2nd trimester, n=240	0 ANC visit, n=1095	
Maternal & sociodemographic characteristi-cs	**Highest** *(Health facility birth & PNC). n*(%)	**High** (*Health facility birth, no PNC). n*(%)	**Slightly high** (*No health facility birth, PNC). n*(%)	**Mod-low** *(No health facility birth, no PNC).* n(%)	**Higher** *(Health facility delivery, PNC). n(%)*	**Mod- high** *(Health facility birth, no PNC). n*(%)	**Mod-lower** *(No health facility birth, PNC). n*(%)	**Very low** *(No health facility birth, no PNC). n* (%)	**Strategic-lowest** *([a]Some facility births and [b]some PNC).* n(%)	**`Unstrategic´-lowest** *([c]Some facility births and [d]some PNC). n* (%)	**2nd lowest** *(Health facility birth, [e]some PNC). n*(%)	**Lowest** (*No health facility births, [f]some PNC)* n(%)
Some – a proportion within that specific category: [a]39%, [b]25%, [c]50%, [d]19%, [e]39%, [f]13%. 1st – first, 2nd – second												*Mod – Moderately*
Desire to have a child,												
No	142(8.7)	215(9.2)	97(12.9)	206(12.3)	249(10.6)	153(11.9)	120(19.0)	257(15.1)	72(22.1)	33(19.8)	18(15)	78(16.5)
Yes	1496(91.3)	2132(90.8)	654(87.1)	1469(87.7)	2106(89.4)	1133(80.1)	512(81.0)	1449(84.9)	254(77.9)	134(80.2)	102(85)	396(83.5)
Who ultimately makes care-seeking decisions												
Respondent alone *(woman)*	1337(32.7)	548(28.6)	229(36.6)	461(32.2)	600(31.9)	343(33.0)	172(33.0)	416(28.9)	75(30.6)	35(28.0)	24(33.3)	81(21.3)
Both	1776(43.5)	834(43.4)	236(37.8)	600(41.9)	834(44.3)	437(42.1)	186(35.7)	612(42.4)	87(35.5)	56(44.8)	23(31.9)	168(44.1)
Husband alone	973(23.8)	537(28.0)	160(25.0)	370(25.9)	448(23.8)	258(24.9)	163(31.3)	414(28.7)	83(33.9)	34(27.2)	25(34.7)	132(34.7)
Parity												
Primiparous	1293(26.1)	1388(26.8)	96(12.8)	324(10.8)	555(23.6)	715(25.7)	68(10.8)	295(9.9)	100(18.5)	51(20.6)	56(31.8)	113(12.2)
Para 2-3	1877(37.8)	2113(40.8)	287(38.2)	988(33.0)	855(36.3)	1061(38.1)	219(34.7)	906(30.5)	100(18.5)	78(31.6)	43(24.4)	236(25.4)

	4 or more ANC visits, n=13888				2-3 ANC visits, n=8744				1 ANC visit in 3rd trimester, n=533	1 ANC visit, in 1st or 2nd trimester, n=240	0 ANC visit, n=1095	
Maternal & sociodemographic characteristi-cs	**Highest** *(Health facility birth & PNC). n*(%)	**High** (*Health facility birth, no PNC). n*(%)	**Slightly high** (*No health facility birth, PNC). n*(%)	**Mod-low** *(No health facility birth, no PNC).* n(%)	**Higher** *(Health facility delivery, PNC). n(%)*	**Mod- high** *(Health facility birth, no PNC). n*(%)	**Mod-lower** *(No health facility birth, PNC). n*(%)	**Very low** *(No health facility birth, no PNC). n* (%)	**Strategic-lowest** *([a]Some facility births and [b]some PNC).* n(%)	**`Unstrategic´-lowest** *([c]Some facility births and [d]some PNC). n* (%)	**2nd lowest** *(Health facility birth, [e]some PNC). n*(%)	**Lowest** (*No health facility births, [f]some PNC)* n(%)
Para 4+	1791(36.1)	1678(32.4)	369(49.0)	1684(56.2)	945(40.1)	1006(36.2)	345(54.6)	1774(59.6)	151(27.9)	118(47.8)	77(43.8)	579(62.4)
Some – a proportion within that specific category: [a]39%, [b]25%, [c]50%, [d]19%, [e]39%, [f]13%. 1st – first, 2nd – second Mod – Moderately												
Wealth status												
Poor	1785(36.0)	1739(33.6)	497(66.1)	1953(65.2)	994(42.2)	1181(42.5)	446(70.6)	2108(70.9)	339(62.7)	152(61.5)	83(47.2)	792(85.3)
Middle	854(17.2)	1031(19.9)	132(17.6)	556(18.5)	457(19.4)	565(20.3)	127(20.1)	498(16.7)	99(18.3)	41(16.6)	31(17.6)	66(7.1)
Rich	2322(46.8)	2409(46.5)	123(16.4)	487(16.3)	904(38.4)	1036(37.2)	59(9.3)	369(12.4)	103(19.0)	54(21.9)	62(35.2)	70(7.6)
Marital status												
Single	859(17.3)	880(17.0)	123(16.4)	435(14.5)	464(19.7)	403(20.6)	109(17.3)	458(15.4)	143(26.4)	57(23.1)	64(36.4)	163 (17.6)
Married	4102(82.7)	4299(83.0)	629(83.6)	2561(85.5)	1891(80.3)	1558(79.5)	523(82.7)	2517(84.6)	398(73.6)	190(76.9)	112(63.6)	765 (82.4)
Some – a proportion within that specific category: [a]39%, [b]25%, [c]50%, [d]19%, [e]39%, [f]13%. 1st – first, 2nd – secondMod – Moderately												

Table 4 shows the results of the multinomial regressions for the associations between independent factors and different classes of care-seeking continuum from pregnancy to childbirth and 28 days postnatal, *lowest* class being reference category. Maternal primary or higher education levels compared to no formal education, were significantly associated with higher care-seeking behaviour in almost all care-seeking categories except among those who had only 1 ANC visit in first/second trimester; relative risk ratios RRRs ranged from 2.1–8.6, (95% confidence intervals [95% CI] 1.2–16.0). Similarly, trends were observed among those with husbands having primary education and above; RRRs ranged from 2.1– 6.8 (95% CI 1.2–11.1). Findings show, the higher the level of education, the higher the care-seeking tendency. Exposure to mass media (radio/television) and desire to have a child were also generally associated with higher care-seeking tendency. However, those who had only 1 or no ANC visits, the desire for a child was not a statistically significant factor for care-seeking.

Distance to the health facility was largely a demotivating factor to care-seeking. In 7 care-seeking categories, the RRRs ranged from 0.5 – 0.7 (95% CI 0.5–0.9), whereas the remaining 4 categories the association was marginally not statistically significant; RRRs ranged from 0.7 – 1.0 (95% CI 0.5–1.5). Higher parity versus primiparous was not associated with care-seeking except in a few care-seeking categories in para 4+, i.e., in the *highest, moderately low* and *very low*.

Maternal age was not significantly associated with care-seeking at any level of care-seeking continuum, RRRs ranged from 0.5 – 1.2 (95% CI 0.4–2.0). Living in a rural area versus urban was associated with about 50% lower care-seeking tendency in 7 categories. Remaining care-seeking categories indicated no significant results. Care-seeking was also notably hindered when the husband/partner rather than the woman made decisions for maternal care-seeking. Other factors such as wealth status and marital status also variably and to a small extent influenced care-seeking behaviour.

Table 4: Multinomial logistic regression showing relative risk ratios (RRR) for the associations between maternal and socio-demographic factors and maternal continuum of care-seeking behaviour in Kenya and Uganda, using demographic and health survey 2014-2016 data.

Maternal & sociodemogr-aphic characteristi-cs	**Highest** *(≥4 ANC visits, health facility birth & PNC).*	**Higher** *(2-3 ANC visits, Health facility delivery, PNC)*	**High** *(≥4 ANC visits, health facility birth, no PNC).*	**Mod- high** *(2-3 ANC visits, health facility birth, no PNC).*	**Slightly high** *(≥4 ANC visits, No health facility birth, PNC).*	**Mod-low** *(≥4 ANC visits, No health facility birth, no PNC).*	**Mod-lower** *(2-3 ANC visits, no health facility birth, PNC).*	**Very low** *(2-3 ANC visits, No health facility birth, no PNC).*	**Strategic-lowest** *(1 ANC visit, 1st contact in 3rd trimester, [a]some facility births and [b]some PNC)*	**`Unstrategic´-lowest** *(1 ANC visit, 1st contact in 1st or 2nd trimester, [c]some facility births and [d]some PNC)*	**2nd lowest** *(No ANC visit, health facility birth, [e]some PNC).*
Versus *lowest* care-seeking level, 95% Confidence Interval (95%CI)											
Maternal education level											
No education	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Primary	3.2 (2.4-4.3)	3.2 (2.4-4.4)	3.4 (2.5-4.7)	2.8 (2.0-3.9)	2.2 (1.5-3.0)	2.3 (1.7-3.1)	2.2 (1.5-3.1)	2.8 (2.1-3.8)	2.1 (1.4-3.3)	1.2 (0.7-2.0)	2.6 (1.3-5.4)
Secondary & higher	8.6 (4.6-16.0)	7.4 (3.9-13.9)	7.4 (3.9-14.1)	5.2 (2.7-10.1)	2.7 (1.4-5.3)	3.4 (1.8-6.4)	4.2 (2.1-8.3)	3.3 (1.7-6.2)	2.7 (1.2-6.0)	1.3 (0.5-3.3)	3.0 (1.0-9.4)
Partner´s education level											
No education	Ref.		Ref.	Ref.		Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Primary	3.3 (2.4-4.5)	3.4 (2.5-4.8)	3.6 (2.6-5.0)	4.5 (3.1-6.7)	2.6 (1.8-3.7)	2.1 (1.6-2.9)	2.6 (1.8-3.7)	2.6 (1.9-3.5)	2.4 (1.5-3.9)	2.1 (1.2-3.7)	1.7 (0.8-3.7)
Secondary & higher	6.0 (3.9-9.3)	5.1(3.3-8.1)	5.9 (3.7-9.3)	6.8(4.1-11.1)	3.5(2.1-5.7)	2.8(1.8-4.4)	3.1(1.9-5.2)	2.7(1.7-4.2)	3.4(1.8-6.2)	2.6(1.2-5.4)	1.6(0.6-4.1)
Distance to nearest health facility is a problem											
No	Ref.	Ref	Ref.	Ref.		Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes *(A big problem)*	0.6 (0.5-0.7)	0.6 (0.5-0.8)	0.7 (0.5-0.8)	0.7 (0.5-0.9)	0.6 (0.5-0.8)	0.8 (0.6-1.0)	0.7 (0.5-0.9)	0.8 (0.7-1.0)	0.7 (0.5-1.0)	1.0 (0.7-1.5)	0.5 (0.3-0.9)
Desired to have a child											
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	1.9 (1.4-2.7)	1.7 (1.2-2.4)	2.1 (1.4-2.9)	1.5 (1.1-2.2)	1.7 (1.2-2.6)	1.9 (1.3-2.7)	1.2 (0.8-17)	1.7 (1.2-2.4)	1.2 (0.7-1.8)	0.9 (0.5-1.7)	1.1 (0.5-2.3)
Mass media exposure											
No	Ref.	Ref.		Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	2.7 (2.1-3.5)	2.3 (1.8-2.9)	2.3 (1.8-2.9)	2.3 (1.7-3.0)	2.5 (1.9-3.3)	1.8 (1.4-2.3)	2.5 (1.9-3.4)	1.5 (1.2-2.0)	2.0 (1.4-2.8)	1.2 (0.8-1.9)	2.0 (1.1-3.7)

Some – a proportion within that specific category: [a]39%, [b]25%, [c]50%, [d]19%, [e]39%. 1st – first, 2nd – second Mod – Moderately

Maternal & sociodemographic characteristics	**Highest** *(≥4 ANC visits, health facility birth & PNC).*	**Higher** *(2-3 ANC visits, Health facility delivery, PNC)*	**High** *(≥4 ANC visits, health facility birth, no PNC).*	**Mod- high** *(2-3 ANC visits, health facility birth, no PNC).*	**Slightly high** *(≥4 ANC visits, No health facility birth, PNC).*	**Mod-low** *(≥4 ANC visits, No health facility birth, no PNC).*	**Mod-lower** *(2-3 ANC visits, no health facility birth, PNC).*	**Very low** *(2-3 ANC visits, No health facility birth, no PNC).*	**Strategic-lowest** *(1 ANC visit, 1st contact in 3rd trimester, [a]some facility births and [b]some PNC)*	**`Unstrategic´-lowest** *(1 ANC visit, 1st contact in 1st or 2nd trimester, [c]some facility births and [d]some PNC)*	**2nd lowest** *(No ANC visit, health facility birth, [e]some PNC).*
Versus *lowest* care-seeking level, 95%CI											
Told about pregnancy complications (only for Kenya)											
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref	-	-
Yes*	2.5 (1.6-4.1)	1.4 (0.9-2.4)	1.9 (1.2-3.1)	1.1 (0.7-1.8)	1.4 (0.9-2.2)	0.7 (0.4-1.2)	1.0 (0.6-1.6)	0.6 (0.7-1.0)	0.5 (0.3-0.9)		-
Who ultimately makes care-seeking decisions											
Respondent alone*(woman)*	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Both partner /respondent	0.6 (0.4-0.8)	0.6 (0.6-0.8)	0.6 (0.5-0.9)	0.5 (0.4-0.7)	0.5 (0.3-0.7)	0.6 (0.4-0.8)	0.5 (0.4-0.7)	0.7 (0.5-0.9)	0.5 (0.4-0.8)	0.7 (0.4-1.3)	0.4 (0.2-0.8)
Husband (partner) alone	0.5 (0.4-0.7)	0.5 (0.4-0.7)	0.7 (0.5-0.9)	0.5 (0.3-0.7)	0.5 (0.3-0.7)	0.5 (0.3-0.7)	0.7 (0.5-0.9)	0.6 (0.5-0.9)	0.7 (0.5-1.1)	0.6 (0.3-1.1)	0.6 (0.3-1.2)
Maternal age											
15-24	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
25-34	1.1 (0.8-1.5)	0.9 (0.6-1.3)	0.8 (0.6-1.1)	0.7 (0.5-1.1)	1.1 (0.7-1.6)	0.7 (0.5-1.0)	1.1 (0.8-1.7)	0.8 (0.5-1.1)	0.6 (0.4-1.1)	0.6 (0.4-1.2)	0.5 (0.2-1.1)
35-49	1.1 (0.8-1.7)	0.9 (0.6-1.4)	0.9 (0.6-1.3)	0.7 (0.4-1.1)	1.2 (0.7-2.0)	0.7 (0.4-1.0)	1.2 (0.7-2.0)	0.9 (0.6-1.4)	0.8 (0.5-1.6)	0.8 (0.4-1.7)	0.5 (0.2-1.4)
Place of residence											
Urban	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Rural	0.5 (0.4-0.8)	0.5 (0.4-0.8)	0.4 (0.3-0.6)	0.6 (0.4-0.8)	0.5 (0.3-0.8)	0.9 (0.6-1.4)	0.5 (0.3-0.7)	0.9 (0.6-1.3)	0.6 (0.4-1.0)	0.4 (0.2-0.7)	0.5 (0.3-1.1)
Marital status											
Single	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Married	3.6 (2.4-5.4)	3.2 (2.9-5.0)	3.8 (2.4-5.9)	3.8 (2.3-6.2)	1.1 (0.7-1.7)	4.4 (2.7-7.1)	1.0 (0.6-1.5)	3.9 (1.9-4.6)	1.4 (0.8-2.6)	2.5 (1.0-6.1)	1.6 (0.6-4.2)

Some – a proportion within that specific category: [a]39%, [b]25%, [c]50%, [d]19%, [e]39%. 1st – first, 2nd – second. Mod – Moderately

Maternal & sociodemographic characteristics	**Highest** *(≥4 ANC visits, health facility birth & PNC).*	**Higher** *(2-3 ANC visits, Health facility delivery, PNC)*	**High** *(≥4 ANC visits, health facility birth, no PNC).*	**Mod- high** *(2-3 ANC visits, health facility birth, no PNC).*	**Slightly high** *(≥4 ANC visits, No health facility birth, PNC).*	**Mod-low** *(≥4 ANC visits, No health facility birth, no PNC).*	**Mod-lower** *(2-3 ANC visits, no health facility birth, PNC).*	**Very low** *(2-3 ANC visits, No health facility birth, no PNC).*	**Strategic-lowest** *(1 ANC visit, 1st contact in 3rd trimester, [a]some facility births and [b]some PNC)*	**`Unstrategic´-lowest** *(1 ANC visit, 1st contact in 1st or 2nd trimester, [c]some facility births and [d]some PNC)*	**2nd lowest** *(No ANC visit, health facility birth, [e]some PNC).*
Wealth status											
	Versus *lowest* care-seeking level, 95%CI										
Poor	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Middle	1.9 (1.3-2.9)	2.1 (1.4-3.2)	2.3 (1.5-3.5)	2.0 (1.3-3.1)	1.4 (0.9-2.2)	2.0 (1.3-3.1)	1.4 (0.9-2.2)	1.6 (1.1-2.5)	1.8 (1.1-3.0)	2.9 (1.5-5.4)	2.0 (1.0-4.5)
Rich	1.9 (1.2-2.8)	1.7 (1.1-2.6)	1.7 (1.1-2.6)	1.7 (1.1-2.6)	0.6 (0.4-0.9)	1.2 (0.8-1.8)	0.3 (0.2-0.5)	0.8 (0.6-1.3)	0.9 (0.5-1.6)	1.6 (0.8-3.1)	2.2 (1.0-4.5)
Parity											
Primiparous	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Para 2-3	0.7 (0.5-1.1)	0.9 (0.6-1.3)	0.8 (0.5-1.3)	0.9 (0.5-1.4)	1.3 (0.8-2.2)	1.4 (0.9-2.2)	1.7 (1.0-2.8)	1.6 (1.0-2.5)	0.9 (0.5-1.7)	1.0 (0.5-2.1)	0.8 (0.3-1.7)
Para 4+	0.5 (0.3-0.9)	0.7 (0.4-1.2)	0.7 (0.4-1.2)	0.8 (0.5-1.4)	0.9 (0.5-1.6)	1.8 (1.1-2.9)	1.3 (0.7-2,2)	1.9 (1.2-3.3)	1.3 (0.6-2.6)	0.9(0.4-2.1)	1.0 (0.4-2.8)

Some – a proportion within that specific category: [a]39%, [b]25%, [c]50%, [d]19%, [e]39%. 1st – first, 2nd – second. Mod – Moderately

Table 5 presents the odds ratios for the associations between continued care-seeking categories and neonatal mortality. Figure 4 shows a forest plots of adjusted odds ratios (aOR) from Table 5, where *2nd lowest* and *lowest* categories versus *highest* were associated with about 4-folds odds of neonatal mortality, aOR 3.8, 95% CI 1.7–8.6. The *higher* category indicated no significant odds for mortality, aOR 1.3 (95% CI 0.7-2.2) while *high* class showed borderline statistically significant association with neonatal mortality, aOR 1.5 (95% CI 1.0-2.3). *Moderately high and very low/moderately low* levels of care-seeking also showed significant higher odds of neonatal death; aOR ranged 1.6 – 2.2 for the two classes. However, the remaining two categories *(Slightly high/moderately lower and Strategic/unstrategic-lowest)* did not indicate any statistically significant association with mortality.

Table 5: Crude and adjusted odds ratios for the association between classes of care-seeking behaviour in continuum of care and neonatal mortality in Kenya and Uganda, using demographic and health survey 2014-2016 data.

Classes of care-seeking behaviour	Crude odds ratio	AOR* (95% CI)
Highest *(≥4 ANC visits, health facility birth & yes PNC).*	Ref.	Ref.
Higher *(2-3 ANC visits, Health facility birth & yes PNC).*	1.5(1.0-2.4)	1.3(0.7-2.2)
High *(≥4 ANC visits Health facility birth & no PNC).*	1.5(1.0-2.2)	1.5(1.0-2.3)
Moderately high *(2-3 ANC visits, health facility birth & no PNC).*	2.4(1.6-3.7)	2.2(1.4-3.4)
Slightly high/moderately lower *(≥ 2 ANC visit, no health facility birth & yes PNC).*	0.4(0.1-1.2)	0.5(0.2-1.3)
Very low/moderately low *(≥ 2ANC visit, no health facility birth & no PNC).*	1.6(1.1-2.3)	1.6(1.1-2.4)
Strategic/`unstrategic´ lowest (3rd lowest), *(1 ANC visit, some (39% in this category) facility births and some (25% in this category) PNC*	1.7(0.8-3.7)	1.9(0.7-5.3)
2nd lowest *(No ANC visit, facility births and some (39% in this category) PNC.*	5.8(2.9-11.6)	3.8(1.7-8.6)
Lowest *(No ANC visit, no facility births and some (13% in this category) PNC.*	4.0(2.3-6.9)	3.8(2.1-6.8)
*adjusted/restricted to birthweight ≥ 2500 g and singleton births		

Figure 5 shows that 22% neonatal deaths were attributable to inadequate maternal care-seeking in the Kenya and Uganda. Insufficient care seeking among *lowest* and *2nd lowest* care-seekers accounted for almost 3-quarters (75%) of neonatal deaths in those groups. More than 9% of neonatal deaths in Kenya and Uganda could be attributable to home births, no PNC visits and inadequate ANC visits.

Discussion

Although 95% of mothers initiated the first ANC visit in Kenya and Uganda, only 20% completed recommended (modified) care attendance of 4 or more ANC visits, health facility birth and at least 1 PNC visit within 28 days after birth. Despite the free maternity policies in first level facilities in Uganda and Kenya, a number of factors still exert profound influence on care-seeking behaviour along the continuum of care that consequently impact neonatal survival. Overall, being educated indicated the highest odds of continual care-seeking, and parental education was 2–9 times associated with care-seeking in almost all care-seeking categories. The higher the education level, the higher tendency to seek care. Our results concur with other studies that have shown associations between education and uptake of ANC,[49,50], institutional birth,[49,51] and PNC,[52]. Further, consistent with our findings, studies have reported higher utilization of obstetric care among mothers exposed to mass media,[53], those that desired to have a child,[50] and those who were married,[54].

Conversely, a husband as the main or joint decision maker concerning maternal health care-seeking was a significant demotivating factor to care-seeking among the women in Kenya and Uganda. A study in Nepal, a similar social setting reported that a complex balance between women´s autonomy and husband´s involvement can enhance maternity care-seeking,[55]. However, gender inequality, negative sociocultural factors and women's financial marginalization tend to hinder women´s autonomy in health care decisions,[56,57]. Also, congruent with our findings, a systematic review in Africa by Dahab et al. reported lack of women autonomy in health decisions and distance to the health facility as major hindrance to maternity care-seeking,[58]. This is exacerbated by poor infrastructure in rural areas,[50]. The positive correlations between ANC and facility birth and PNC indicate that even the first contact with health personnel can improve continued care utilization and these findings concur with other studies,[59,60].

The *2nd lowest* and *lowest* care-seeking category accounted for 75% of within-category neonatal deaths each, and a total of 7.3% deaths in the total population. Even though these two *lowest* categories had the highest within-category attributable mortality risks, they contributed relatively lower country-wide attributable deaths partly because there were rather fewer mothers in these categories. However, the mothers in the *very low/moderately low* category had home births and no PNC and although these mothers received some considerable better care that halved within-category deaths relative to *lowest* class, it

accounted for 9 % of neonatal deaths in the entire population due to the fact that most mothers were in this category.

The far-reaching impacts of maternal and sociodemographic factors on maternal care-seeking continuum necessitate both short and long-term solutions with overarching implications for policy improvements. It may be noted that the 2030 Sustainable Development Goals (SDG) 4, 5 and 10 that focus on inclusive education and gender equality and reducing inequalities resonate closely with most of the long - and short - term recommendations emanating from our findings. In the long-term, strengthening child and adult education especially "weaker" female education with purposeful emphasis on maternity care-seeking should be integrated into the educational curriculum. A recent systematic review in SSA recommended female education as a strong enabling factor for ANC visits,[20]. Inculcating knowledge and skills to empower women's health-decision making and supportive social systems to ensure completion of the care-seeking continuum are critical.

Given the findings in Figure 4, the results in the first 3 care-seeking classes and last 2 classes seem to corroborate theoretical expectations in the hierarchy of inadequate care-seeking consequences. However, the odds for neonatal mortality in *class 4* and *class 6* were not statistically significant, although these two categories would be expected to indicate significant higher deaths. Perhaps these mothers experienced no or minimal complications and therefore did not seek hospital delivery. Notably, *class 4* mothers were over 4 times fewer than their counterparts in similar ANC categories. It is common for mothers who deliver outside health facilities not to seek PNC,[61], and that accounts for the relatively few numbers in *class 4*. Similarly, *class 6* were from ANC strata with the lowest counts and that could have influenced the outcome of our mortality analysis. The aOR for *class 4* was reasonably well below 1.0 and even though not statistically significant, it indicated that PNC could be very protective, when comparisons are made with *high, moderately high* and *moderately low/very low* categories that had similar number of ANC visits but no PNC. PNC is critical for neonatal survival, but our findings show it is the least attended-to component of care continuum. WHO and other studies agree that PNC is a crucial phase yet most neglected part of care,[62,63]. We recommend strategies that enhance PNC utilization in Kenya and Uganda. One such strategy would be to emphasize PNC right from the first ANC contact, which has not been the case. PNC attendance exists only in the checklists for fourth ANC visit in the focused ANC recommendations in both Kenya and Uganda,[64,65]. This implies

that majority of mothers with less than 4 ANC visits get very limited information to induce PNC attendance.

Although it was not possible for our study to determine attributable mortality risks for each specific care component, nonetheless, we can deduce that over 22 % of neonatal deaths in Kenya and Uganda could be avoided through basic maternal and newborn care attendance. We can also conclusively reason that if Kenya and Uganda would fully implement the current WHO recommendations of 8 ANC visits, facility births and ensure PNC, then much higher proportions of neonatal deaths would be eliminated.

Problems with distance to the health facility are compounded for an unsupported mother in labour or with a newborn trying to reach the health facility. Strategies at family, community and at health facility levels could be aligned to support care-seeking especially PNC. At first ANC visit when most mothers in Kenya and Uganda seek contact with health care, telephone communication with husband/partner, guardians ought to be initiated with focus on care-seeking support to the mother and the newborn. Telephone communication is readily available in East Africa, prompting telephone reminders to mothers and their spouses to seek full maternity care ought to be an established strategy in these health care systems. In case of emergencies, mothers in remote areas could have a direct call-line to the nearest health facility and where possible home visits could be planned. Deploying health personnel that live nearer to the new mother-to-be could be cost-effective. Scaling up sustainable mhealth infrastructure to cover remote maternity care is another feasible strategy that can be explored.

Studies in Kenya and Uganda reported increased utilization of ANC and delivery services due to free maternity policy,[66-68]. Reports evaluating impacts of free maternity policies in Kenya and Uganda highlight increase of ANC coverage and health facility births but almost no mention is made of the impact on PNC,[69,70]. Other studies have reported that free maternity policy increased mainly facility births,[71,72]. The universal health policy in Uganda and the *Linda mama* strategy,[73] in Kenya advocate for universal access to quality maternity health services but do not offer transportation for poor mothers or health providers in/to remote areas, yet most mothers are rural dwellers.

Another worthwhile strategy to improve care utilization would be to develop an evidence-based standard framework for ranking or classifying mothers on the basis of their care-

seeking behaviour or levels of the sort used in this present study. Thereafter, appropriate communication strategies could be adopted to enhance continual maternal care utilization. For first-time mothers, at first ANC visit, conducting a brief interview using a brief evidence-based standard questionnaire that takes into account major sociodemographic and maternal factors determinants of care-seeking could help classify a mother. For non-first-time mothers, history of maternal care-seeking could be used. This strategy would require further reviews and research using large population-based data combining countries with free maternity policies in low- and middle-income countries and capturing details of care components at each care contact.

Methodological considerations

The large sample size of the maternal and child data of the latest Kenya and Uganda DHS, which are nationally representative allowed for valid stratified analysis for deeper understanding of neonatal health and survival. Like many cross-sectional surveys, recall bias may not be completely eliminated from the study. Nonetheless, by selecting the most recent live births for analysis and owing to the fact that childbirth is a special occurrence that mothers may not easily forget within a short period of time, our findings are of considerable reflect the reality of maternal care and associated neonatal survival in these countries.

A strength to our study was the use of directed acyclic graphs that enabled us to explicitly map the predictor-outcome relationship for well guided analysis and identification of possible confounders. Our study could not examine other factors such as poor attitude of nurses and lack of information on health care services which have been found by both quantitative and qualitative studies to hinder care utilization in low- and middle-income countries,[74,75]. Another limitation to our study was that inadequate facilities and drugs have also been associated with poor care-seeking, but our data did not capture these specific aspects,[76]. Due to very small numbers in some strata in categories with 1 or no ANC visits such as in, we combined certain strata to allow for reasonable analysis. This may have slightly reduced or obscured the effect of especially absence-of-care in those specific categories. However, such mixed effects were almost negligible in the *lowest* class.

Conclusion

Large-scale population-based research and reviews could enable optimal standard classification for ranking maternal care-seeking behaviours. This in turn can be used by care

providers to promptly identify a mother´s care-seeking level and subsequently adopt new strategies to close the gaps in the maternal care-seeking continuum. Health workers could be trained to equally emphasize attendance to all components of care including PNC which is underutilized.

Acknowledgments

Much appreciation to the DHS programme and partners for availing the datasets for this study.

Competing interest statement

No competing interests were reported by the authors.

Ethics approval statement

ICF Macro International, the primary data collector obtained written consent from willing participants and Ethical approval from respective countries. The participants remain anonymous and are practically impossible to trace. The ICF Macro international and MEASURE DHS abide fully by the international guidelines for epidemiological studies as required by the Council of International Organization of Medical Science (CIOMS) and National guidelines from respective countries for research involving human subjects. Also, DHS measures comply with the United States Department of Health and Human Services regulations for protection of human subjects. DHS data collection process and storage guaranteed the anonymity and confidentiality of participants. Datasets are publicly available at https://dhsprogram.com/data/available-datasets.cfm and permission for access and use for this study was obtained after sending a request to the DHS secretariat. Secondary research such as the present study, that use publicly available data that is not linked to any individual or community are exempted from the requirement of ethics approval.

Funding

No funds were obtained from any entity or industry by the authors of this study.

Authors' contributions

MOA conceptualized, designed, obtained data for the study, conducted analysis, drafted and reviewed the manuscript. BOA and AA interpreted the results and conducted critical review of the manuscript. The final draft was agreed upon by all authors.

References

1. United Nations Inter-Agency Child Mortality Estimation. Levels and trends in child mortality 2020. https://www.unicef.org/media/79371/file/UN-IGME-child-mortality-report-2020.pdf.pdf (accessed Jan 2021)
2. Neonatal Mortality. Neonatal period is the most vulnerable time for a child. UNICEF. 2020. https://data.unicef.org/topic/child-survival/neonatal-mortality/ (accessed Jan 2021).
3. World Health Organization. Newborn death and illness 2011. https://www.who.int/pmnch/media/press_materials/fs/fs_newborndealth_illness/en/ (accessed Jan 2021).
4. World Health Organization. Newborn death and illness 2005. https://www.who.int/pmnch/media/press_materials/fs/fs_newborndealth_illness/en/ (accessed Jan 2021).
5. World Health Organization. Newborns: improving survival and well-being: key facts 2020. https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality (accessed Jan 2021).
6. World Health Organization. Positive experiences, key to antenatal care uptake and quality 2019. https://www.who.int/reproductivehealth/antenatal-care-uptake/en/ (accessed Jan 2021).
7. World Health Organization. Newborns: improving survival and well-being 2020. https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality (accessed Jan 2021).
8. Swedish Public Health Agency (Folkhälsomyndigheten). Infant mortality (Spädbarnsdödlighet) 2019. https://www.folkhalsomyndigheten.se/folkhalsorapportering-statistik/tolkad-rapportering/folkhalsans-utveckling/resultat/halsa/spadbarnsdodlighet/ (accessed Feb 2021).
9. UN IGME. Levels and trends in child mortality report 2019. Estimates developed by the UN Inter-agency Group for Child Mortality Estimation. 2019.
10. Tessema ZT, Yazachew L, Tesema GA, et al. Determinants of postnatal care utilization in sub-Saharan Africa: a meta and multilevel analysis of data from 36 sub-Saharan countries. Ital J Pediatr. 2020;46(1):175.
11. Tran TK, Nguyen CT, Nguyen HD, et al. Urban - rural disparities in antenatal care utilization: a study of two cohorts of pregnant women in Vietnam. BMC Health Serv Res. 2011;11:120.
12. Doctor HV, Nkhana-Salimu S, Abdulsalam-Anibilowo M. Health facility delivery in sub-Saharan Africa: successes, challenges, and implications for the 2030 development agenda. BMC Public Health. 2018;18(1):765.
13. World Health Organization. Make every mother and child count. Geneva, Switzerland; 2005.
14. Kerber KJ, de Graft-Johnson JE, Bhutta ZA, et al. Continuum of care for maternal, newborn, and child health: from slogan to service delivery. Lancet. 2007;370(9595):1358-69.
15. Benova L, Dennis ML, Lange IL, et al. Two decades of antenatal and delivery care in Uganda: a cross-sectional study using Demographic and Health Surveys. BMC Health Serv Res. 2018;18(1):758.
16. Kichamu G AJ, Karimurio L. Maternal and Child Health: Demographic and health survey.
17. Moller AB, Petzold M, Chou D, Say L. Early antenatal care visit: a systematic analysis of regional and global levels and trends of coverage from 1990 to 2013. Lancet Glob Health. 2017;5(10):e977-e83.

18. Gilson L, McIntyre D. Removing user fees for primary care in Africa: the need for careful action. Bmj. 2005;331(7519):762-5.
19. Andersen R, Newman JF. Societal and individual determinants of medical care utilization in the United States. Milbank Mem Fund Q Health Soc. 1973;51(1):95-124.
20. Okedo-Alex IN, Akamike IC, Ezeanosike OB, et al. Determinants of antenatal care utilisation in sub-Saharan Africa: a systematic review. BMJ Open. 2019;9(10):e031890.
21. Neupane B, Rijal S, G CS, Basnet TB. Andersen's model on determining the factors associated with antenatal care services in Nepal: an evidence-based analysis of Nepal demographic and health survey 2016. BMC Pregnancy Childbirth. 2020;20(1):308.
22. Jadoon B, Mahaini R, Gholbzouri K. Determinants of over and underuse of caesarean births in the Eastern Mediterranean Region: an updated review. East Mediterr Health J. 2019;25(11):837-46.
23. Gu H, You H, Yan Z, et al. Determinants of the utilization of postpartum family visits: Evidence from rural areas of Eastern China. PLoS One. 2018;13(3):e0194061.
24. Shitie A, Assefa N, Dhressa M, et al. Completion and Factors Associated with Maternity Continuum of Care among Mothers Who Gave Birth in the Last One Year in Enemay District, Northwest Ethiopia. J Pregnancy. 2020;2020:7019676.
25. Oh J, Moon J, Choi JW, et al. Factors associated with the continuum of care for maternal, newborn and child health in The Gambia: a cross-sectional study using Demographic and Health Survey 2013. BMJ Open. 2020;10(11):e036516.
26. Mohan D, LeFevre AE, George A, et al. Analysis of dropout across the continuum of maternal health care in Tanzania: findings from a cross-sectional household survey. Health Policy Plan. 2017;32(6):791-9.
27. Downe S, Finlayson K, Tunçalp Ö, et al. Provision and uptake of routine antenatal services: a qualitative evidence synthesis. Cochrane Database Syst Rev. 2019;6(6):Cd012392.
28. World Health Organization. Africa´s newborns–counting them and making them count. https://www.who.int/pmnch/media/publications/aonsection_I.pdf (accessed Feb 2021).
29. Masaba BB, Mmusi-Phetoe RM. Neonatal Survival in Sub-Sahara: A Review of Kenya and South Africa. J Multidiscip Healthc. 2020;13:709-16.
30. The World Bank. Open Data, indicators, neonatal (per 1000 live births)-Kenya, Uganda, Rwanda. 1994–2019. February 2021 https://data.worldbank.org/indicator/SH.DYN.NMRT?locations=KE-UG-RW.
31. Kenya National Bureau of Statistics. 2019 Kenya Population and Housing Census.: Distribution of population by socio-economic characteristics. 2019.
32. Uganda Bureau of Statistics (UBOS). 2020 Statistics abstract. 2020.
33. Uganda National Web Portal. Agriculture 2021. March 2021. https://www.gou.go.ug/content/agriculture.
34. The World Bank. Open data source: Agriculture and Rural Development 202. March 2021. Available from: https://data.worldbank.org/topic/agriculture-and-rural-development?locations=KE-UG.
35. Uganda Bureau of Statistics (UBOS). Population and Census 2020. March 2020. https://www.ubos.org/explore-statistics/20/.
36. The World Bank. Open data source: Life expectancy at birth, females - Kenya, Uganda. March 2021 https://data.worldbank.org/indicator/SP.DYN.LE00.FE.IN?locations=KE-UG.
37. Leone T, Cetorelli V, Neal S, et al. Financial accessibility and user fee reforms for maternal healthcare in five sub-Saharan countries: a quasi-experimental analysis. BMJ Open. 2016;6(1):e009692.

38. Croft TA, MJ. Allen, K, et al. Guide to DHS Statistics. Rockville Maryland, USA:_ICF. 2018.
39. ICF International. Demographic and Health Survey: Interviewer´s manual. 2019: Rockville, Maryland.
40. Asamoah BO, Agardh A, Cromley EK. Spatial analysis of skilled birth attendant utilization in Ghana. Glob J Health Sci. 2014;6(4):117-27.
41. Sandberg J, Odberg PK, Asp G, et al. Inadequate knowledge of neonatal danger signs among recently delivered women in southwestern rural Uganda: a community survey. PLoS One. 2014;9(5):e97253.
42. Fisseha G, Berhane Y, Worku A, et al. Distance from health facility and mothers' perception of quality related to skilled delivery service utilization in northern Ethiopia. Int J Womens Health. 2017;9:749-56.
43. Mwilike B, Nalwadda G, Kagawa M, et al. Knowledge of danger signs during pregnancy and subsequent healthcare seeking actions among women in Urban Tanzania: a cross-sectional study. BMC Pregnancy Childbirth. 2018;18(1):4.
44. Asp G, Odberg PK, Sandberg J, et al. Associations between mass media exposure and birth preparedness among women in southwestern Uganda: a community-based survey. Glob Health Action. 2014;7:22904.
45. Ahinkorah BO, Budu E, Seidu AA, et al. Barriers to healthcare access and healthcare seeking for childhood illnesses among childbearing women in sub-Saharan Africa: A multilevel modelling of Demographic and Health Surveys. PLoS One. 2021;16(2):e0244395.
46. Adedokun ST, Yaya S. Factors influencing mothers' health care seeking behaviour for their children: evidence from 31 countries in sub-Saharan Africa. BMC Health Serv Res. 2020;20(1):842.
47. Chakraborty NM, Fry K, Behl R, et al. Simplified Asset Indices to Measure Wealth and Equity in Health Programs: A Reliability and Validity Analysis Using Survey Data From 16 Countries. Glob Health Sci Pract. 2016;4(1):141-54.
48. Textor J ZBV, Gilthorpe M.K, et al. Robust causal inference using directed acyclic graphs: the R package 'dagitty'.
. International Journal of Epidemiology 2016;45(9):1887-94.
49. Enos JY, Amoako RD, Doku IK. Utilization, Predictors and Gaps in the Continuum of Care for Maternal and Newborn Health in Ghana. Int J MCH AIDS. 2021;10(1):98-108.
50. Tekelab T, Chojenta C, Smith R, et al. Factors affecting utilization of antenatal care in Ethiopia: A systematic review and meta-analysis. PLoS One. 2019;14(4):e0214848.
51. Nigusie A, Azale T, Yitayal M. Institutional delivery service utilization and associated factors in Ethiopia: a systematic review and META-analysis. BMC Pregnancy Childbirth. 2020;20(1):364.
52. Tolera H, Gebre-Egziabher T, Kloos H. Risk factors for women's non-utilization of decentralized primary health care facilities for postnatal care in rural western Ethiopia. Ther Adv Reprod Health. 2020;14:2633494120928340.
53. Acharya D, Khanal V, Singh JK, et al. Impact of mass media on the utilization of antenatal care services among women of rural community in Nepal. BMC Res Notes. 2015;8:345.
54. Rwabufigiri BN, Mukamurigo J, Thomson DR, et al. Factors associated with postnatal care utilisation in Rwanda: A secondary analysis of 2010 Demographic and Health Survey data. BMC Pregnancy Childbirth. 2016;16(1):122.
55. Thapa DK, Niehof A. Women's autonomy and husbands' involvement in maternal health care in Nepal. Soc Sci Med. 2013;93:1-10.
56. Sumankuuro J, Crockett J, Wang S. Sociocultural barriers to maternity services delivery: a qualitative meta-synthesis of the literature. Public Health. 2018;157:77-85.

57. Ganle JK, Obeng B, Segbefia AY, et al. How intra-familial decision-making affects women's access to, and use of maternal healthcare services in Ghana: a qualitative study. BMC Pregnancy Childbirth. 2015;15:173.
58. Dahab R, Sakellariou D. Barriers to Accessing Maternal Care in Low Income Countries in Africa: A Systematic Review. Int J Environ Res Public Health. 2020;17(12).
59. Fekadu GA, Kassa GM, Berhe AK, et al. The effect of antenatal care on use of institutional delivery service and postnatal care in Ethiopia: a systematic review and meta-analysis. BMC Health Serv Res. 2018;18(1):577.
60. Atuhaire R, Atuhaire LK, Wamala R, et al. Interrelationships between early antenatal care, health facility delivery and early postnatal care among women in Uganda: a structural equation analysis. Glob Health Action. 2020;13(1):1830463.
61. Chungu C, Makasa M, Chola M, et al. Place of Delivery Associated With Postnatal Care Utilization Among Childbearing Women in Zambia. Front Public Health. 2018;6:94.
62. Tiruneh GT, Worku A, Berhane Y, et al. Determinants of postnatal care utilization in Ethiopia: a multilevel analysis. BMC Pregnancy Childbirth. 2020;20(1):549.
63. World Health Organization. WHO recommendations on postnatal care of the mother and newborn. Geneva, Switzerland: World health Organization; 2014.
64. Ministry of health. Essential Maternal and Newborn Clinical Care Guidelines For Uganda. 2016.
65. Ministry of Public Health and Saniatioan and Ministry of Medical Services. National Guidelines for quality obstetrics and perinatal care
66. Lang'at E, Mwanri L, Temmerman M. Effects of implementing free maternity service policy in Kenya: an interrupted time series analysis. BMC Health Serv Res. 2019;19(1):645.
67. Atuoye KN, Barnes E, Lee M, et al. Maternal health services utilisation among primigravidas in Uganda: what did the MDGs deliver? Global Health. 2020;16(1):40.
68. Njuguna J, Kamau N, Muruka C. Impact of free delivery policy on utilization of maternal health services in county referral hospitals in Kenya. BMC Health Serv Res. 2017;17(1):429.
69. Abuya T DM, Amanda D et al. Impacts of removing user fees for maternal health services on universal health coverage in Kenya. 2018.
70. Odokonyero T MF, Adong A, et al. Universal health coverage in Uganda: The critical health infrastructure, healthcare coverage and equity. 2017.
71. Tama E, Molyneux S, Waweru E, et al. Examining the Implementation of the Free Maternity Services Policy in Kenya: A Mixed Methods Process Evaluation. Int J Health Policy Manag. 2018;7(7):603-13.
72. Gitobu CM, Gichangi PB, Mwanda WO. The effect of Kenya's free maternal health care policy on the utilization of health facility delivery services and maternal and neonatal mortality in public health facilities. BMC Pregnancy Childbirth. 2018;18(1):77.
73. Ministry of Health Kenya. Linda Mama Programme positioning Kenya on the Pathway to UHC, Health PS 2020.
74. Nachinab GT, Adjei CA, Ziba FA, et al. Exploring the Determinants of Antenatal Care Services Uptake: A Qualitative Study among Women in a Rural Community in Northern Ghana. J Pregnancy. 2019;2019:3532749.
75. Kyei-Nimakoh M, Carolan-Olah M, McCann TV. Access barriers to obstetric care at health facilities in sub-Saharan Africa-a systematic review. Syst Rev. 2017;6(1):110.
76. Xu K, Evans DB, Kadama P, et al. Understanding the impact of eliminating user fees: utilization and catastrophic health expenditures in Uganda. Soc Sci Med. 2006;62(4):866-76.

Figure legends

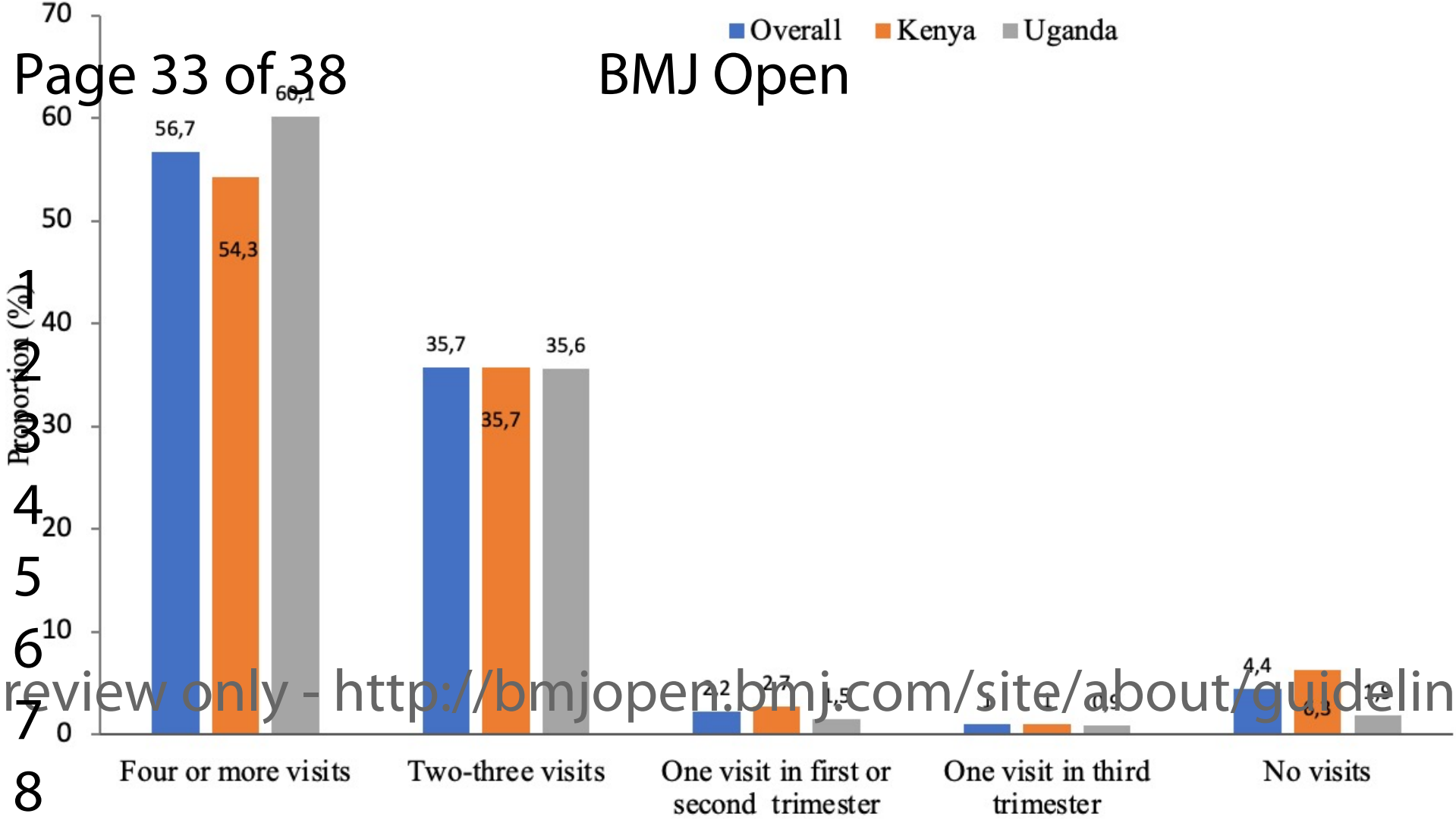
Figure 1: Proportions of antenatal care visits by number of ANC contacts in Kenya and Uganda, using demographic and health survey 2014-2016 data.

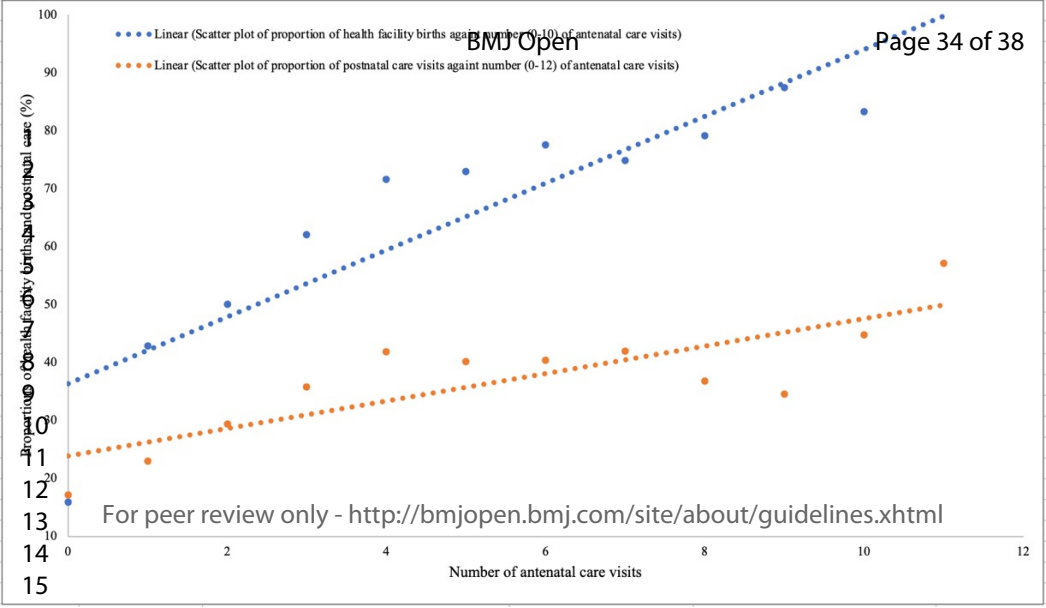
Figure 2. A scatter plot showing correlation between number of antenatal care visits and proportions of facility births and postnatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

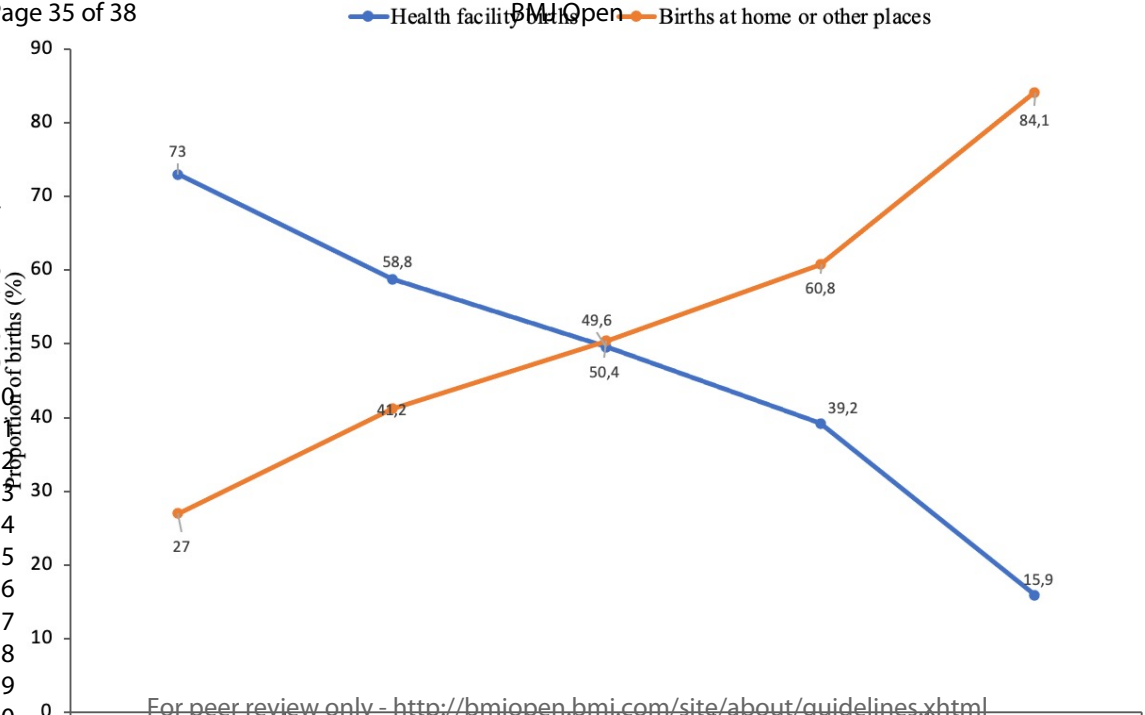
Figure 3. Proportion of hospital and home births by number of antenatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

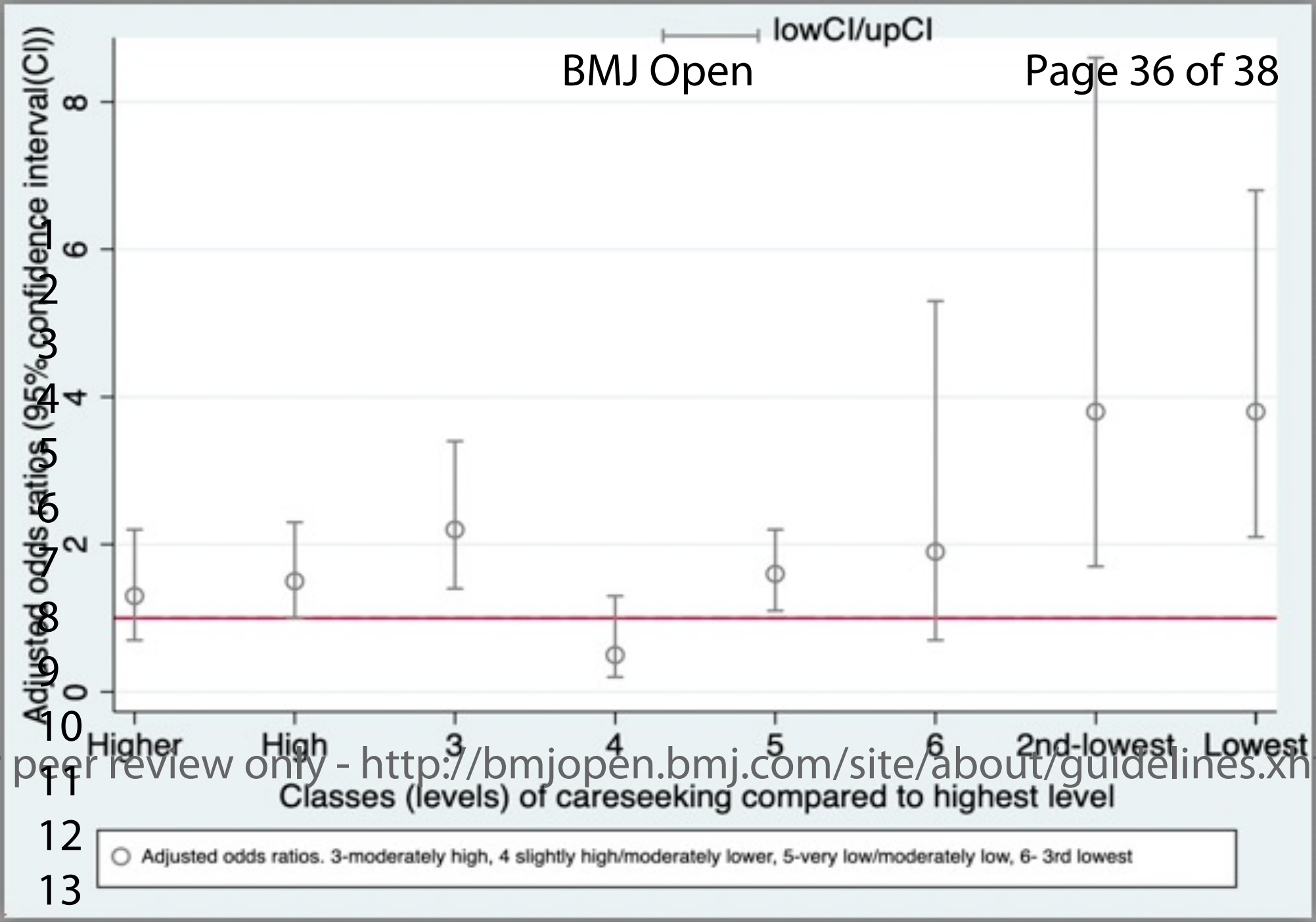
Figure 4: A forest plot showing adjusted odds ratios between continued care-seeking behavioral classes/levels and neonatal mortality, using Kenya and Uganda, 2014-2016 demographic and health survey data.

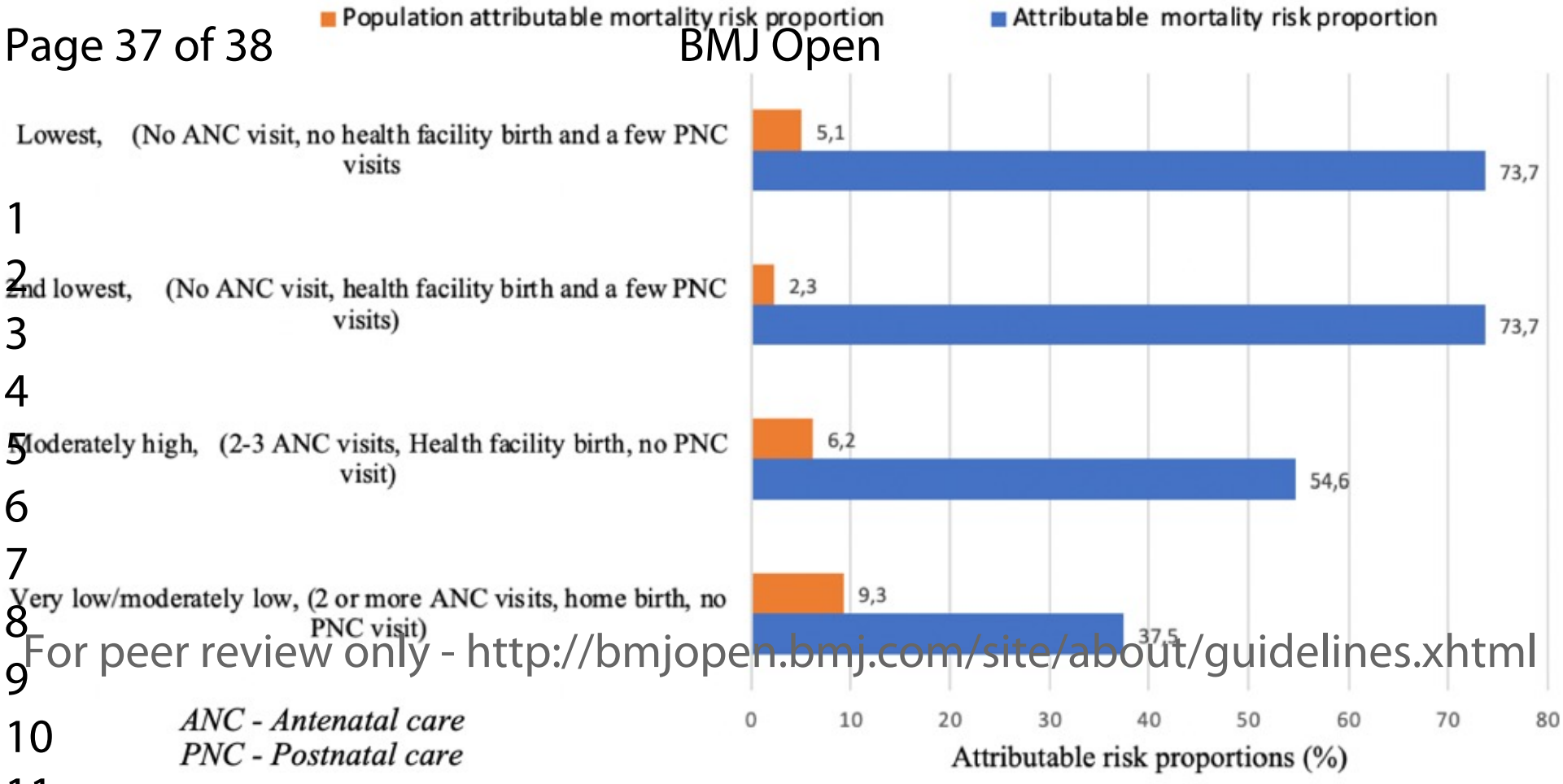
Figure 5: Attributable and population attributable neonatal mortality risk proportion for lower categories of care-seeking in Kenya and Uganda, using demographic and health survey 2014-2016 data.











Supplementary file 1.

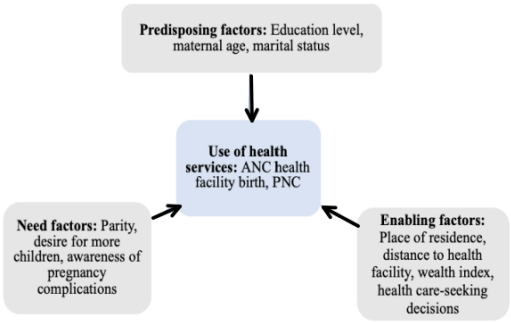


Figure showing behavioral model of utilization of health care services, modified from Andersen and Newman model.

Supplementary file 2.

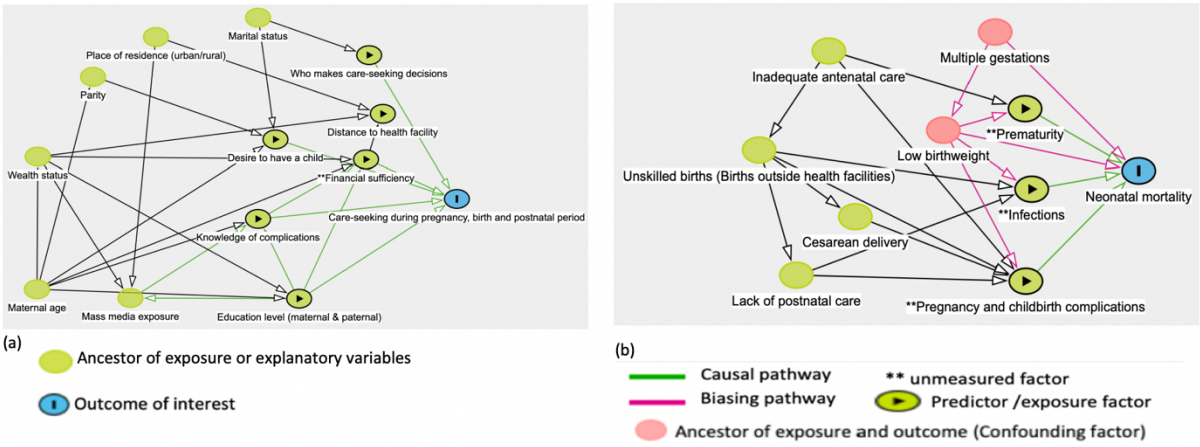


Figure 1: Directed acyclic graphs showing the predictor–outcome relationship for both care-seeking and neonatal survival in Kenya and Uganda, *(Developed from www.dagitty.net, using DAGitty version 3.0.)*

BMJ Open

Determinants of continued maternal care-seeking during pregnancy, birth and postnatal and associated neonatal survival outcomes in Kenya and Uganda: analysis of cross-sectional, demographic and health survey data.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-054136.R1
Article Type:	Original research
Date Submitted by the Author:	21-Sep-2021
Complete List of Authors:	Arunda , Malachi; Lund University, Social Medicine and Global Health, Department of Clinical Sciences, Malmö. Agardh, Anette; Lund University, Social Medicine and Global Health, Department of Clinical Sciences, Malmö Malmö, SE Asamoah, Benedict ; Lund University, Social Medicine and Global Health, Department of Clinical Sciences, Malmö
Primary Subject Heading:	Global health
Secondary Subject Heading:	Reproductive medicine
Keywords:	EPIDEMIOLOGY, PUBLIC HEALTH, Community child health < PAEDIATRICS

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Determinants of continued maternal care-seeking during pregnancy, birth and postnatal and associated neonatal survival outcomes in Kenya and Uganda: analysis of cross-sectional, demographic and health survey data.

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Abstract

Objectives: To examine how maternal and sociodemographic factors determine continued maternal care-seeking behaviour from pregnancy to postnatal period in Kenya and Uganda and to estimate associated neonatal survival outcomes.

Method: Using population-based cross-sectional survey data for Uganda and Kenya, 2014-2016, we employed multinomial regression to examine how maternal and sociodemographic factors predict continuity of care-seeking. Associated neonatal survival outcomes were assessed using binary logistic regression.

Results: Overall, 57% of mothers had 4 or more antenatal care contacts, of which 73% and 41% had facility births and postnatal care, respectively. Maternal and paternal education versus no education were associated with continued care-seeking in majority of care-seeking classes; relative risk ratios, RRR ranged from 2.1–8.0 (95% confidence intervals [95% CI] 1.1–16.3). Similarly, exposure to mass media was generally associated with continued care-seeking, RRRs ranged from 1.8– 3.2 (95% CI 1.2–5.4). However, care-seeking tendency reduced if a husband made major maternal care-seeking decisions. Transportation problems and living in rural versus urban were largely associated with lower continued care utilization, RRR ranged from 0.4 – 0.7 (95% CI 0.3–0.9). The two *lowest* care-seeking categories with no ANC and no PNC indicated the highest odds for neonatal mortality, aOR 4.2 (95% CI_{range} 1.6-10.9). 23% neonatal deaths were attributable to inadequate maternal care attendance.

Conclusion: Strategies such as mobile health (mHealth) specifically for promoting continued maternal care utilization up to postnatal could be integrated in the existing structures. Another strategy would be to develop and employ a brief standard questionnaire to determine a mother´s continued care-seeking level during the first ANC visit and use the information to close the care-seeking gaps where most needed. Strengthening the community health workers system to be integral part of promoting continued maternal care-seeking could enhance care-seeking as a stand-alone strategy or as a component of both previously suggested strategies above.

Keywords: Continued care-seeking behaviour, neonatal mortality.

Strengths and limitations of this study

- The nationally representativeness of the data and the large sample size of the study allowed for valid stratified analysis with implications for national policy developments to improve neonatal survival outcomes for countries in sub-Saharan Africa region.

- Recall bias may not be completely eliminated from the study since the data was collected retrospectively through interviews.

- However, by selecting the most recent births and owing to the fact that childbirth is a special event not easily forgettable, the study findings reflect the reality with considerable validity.

- The study was based on maternal attendance to care and not the actual obstetric services received thus aspects related to lack of drugs, inadequate facilities or quality of care were not captured in our study.

Introduction

In 2019, close to 7000 newborns worldwide died within their first 28 days of life (neonatal period), as per the United Nations Inter-Agency Group for Child Mortality Estimation [1]. Roughly three-quarters of these deaths occurred during childbirth and the first week of neonatal period [1, 2] and the major causes included infections such as sepsis and pneumonia, birth complications and prematurity-related problems such as asphyxia and low birthweight [3]. Comprehensive antenatal care (ANC), skilled birth attendance and postnatal (afterbirth) care (PNC) have long been recognized as key strategies that profoundly contribute to newborn survival [4, 5]. In 2015, 64% of women globally had 4 or more ANC contacts [6] and prevalence of health facility births was 80% in 2019 [7]. In high income countries such as in Sweden where neonatal death rate is among the lowest globally (1.4 deaths per 1000 live births, in 2019), almost all mothers obtain comprehensive ANC, facility births and PNC services [8]. However, in sub-Sahara African (SSA) and southeast Asian countries where over 70 percent of all neonatal deaths occur [9], utilization of the components of care is relatively low and vary substantially [10-12].

Accordingly, since 2005, the World Health Organization (WHO) has been advocating for the implementation of continuum of care strategy [13], a concept that promotes continual access to care from pre-pregnancy to the first few weeks of after childbirth [13,14]. While several SSA countries including Kenya and Uganda report over 80% coverage of at-least-one ANC contact with skilled provider [15,16], late initiation of ANC visits, lower health facility births and very low PNC utilization still pose enormous challenges. A Lancet study reported that prevalence of early initiation of ANC contact (<14 weeks gestation) was only 24% in SSA, much lower compared to 85% in high income countries [17]. The challenge in a number of SSA countries, however, is that despite the removal of user fees for all maternal and child health service in many countries, a number of sociodemographic factors and maternal characteristics still remain critical determinants of care utilization that hinder or motivate choices and preferences in maternal care-seeking [18].

Andersen and Newman behavioral model of utilization of health care services has widely been used to identify factors that influence care-seeking behavior [19]. The model outlines three main factors that interact to predict utilization of care and they included societal, individual and health system determinants [19]. See diagrammatic details in Supplementary file 1. The model has been employed by studies to examine utilization of the different

components of maternal and newborn care such as ANC [20, 21], childbirth [22] or PNC [23]. However, very few studies in SSA have assessed how factors in the Andersen and Newman model modify care-seeking behavior along the continuum of care from pregnancy to postnatal period, and even much fewer within the context of free maternity policy.

A recent community-based study in Ethiopia showed that women with higher education, married women, and those with autonomy in health care decision were likely to complete continuum of care [24]. Whereas the study provided critical findings, it considered only 1 ANC visit and not the WHO or Ministry of Health (MoH) recommended number of contacts [24]. Another similar study by Oh et al. in 2013 in Gambia also found a number of factors associated with maternal care-seeking continuum and early ANC visits [25]. However, the study lacked PNC estimates for facilities deliveries [25]. Another sub-nationally study in Tanzania found, among other factors, knowledge or experience of pregnancy danger signs was associated with higher care-seeking [26]. A 2019 Cochrane review of several qualitative studies found that influence by others, illness-free pregnancy, financial dependence, and selective use of ANC as potential barriers to continual maternal care utilization [27]. The few existing studies on continuum of care-seeking in SSA are very informative but limited in one way or another, and none to our knowledge examined associated neonatal survival outcomes.

Kenya and Uganda are among the 10 countries in SSA countries with most neonatal deaths [28] and despite relatively free or subsidized maternity policy in both countries and relatively higher gross domestic product (GDP) than some countries in the East Africa region such as Rwanda, neonatal mortality rates have declined much slower compared to Rwanda [29, 30]. Thus, this study aims to examine how sociodemographic and maternal factors influence care-seeking behaviour in the care-seeking continuum from pregnancy, childbirth to postnatal period in Kenya and Uganda. A secondary aim was to estimate the impact of levels of continued maternal care-seeking on neonatal survival.

Methods

Study settings

Kenya and Uganda have closely comparable demographics and are in relatively similar state of maternal health care policy and pathway towards achieving universal coverage. The total population in Kenya and Uganda as of 2016-2019 was about 90 million [31, 32]. More than 70 % of the populations live in the rural areas with agriculture as their main source of

livelihood [31, 33, 34]. The sex ratio is approximately 1:1 [31, 35] and general life expectancy at birth in 2016 was similar in both countries, for females it was 64 and 67 years in Uganda and Kenya, respectively [36]. Maternal mean age at first childbirth is 19–20 years. Neonatal mortality rates in both countries were about 22 deaths per 1000 live births in 2016 [30]. Like a number of countries in SSA, Kenya and Uganda provide free maternal care services in primary level health facilities [37]. Although the goal of the free maternity programmes in Kenya and Uganda is to eliminate all maternity-related costs, however, due to inadequate or slow distribution of funding in some health facilities, certain hidden costs such as for ultrasound, access to hospital card and laboratory services among others are still incurred out-of-pocket [38-42]. Additionally, indirect expenses such as costs of transportation to the health facility are still challenges common among poor households [39]. Further, in Kenya, prior to June 2013 maternal services were partly free and partly subsidized [43].

Data source and study design

We obtained the cross-sectional, population-representative, demographic and health survey (DHS) datasets for Kenya 2014 and Uganda 2016 after a formal request to the DHS secretariat. DHS collects sociodemographic, maternal and child health data across the whole country in a two-stage cluster sampling procedure. The DHS uses standard procedures and protocols that ensure complete anonymity of the respondents and adherence to international ethical standards for research. We utilized the data for the most recent live births, 1-59 months prior to the surveys. More details on data collection procedure can be accessed from DHS methodology and manuals [44, 45].

Study variables

Outcome variables

Care-seeking continuum was the primary outcome variable. It constituted a combination of the number of ANC visits, health facility birth and at least one PNC contact within 28 days postpartum (after birth). Continuum of care-seeking was categorized into 15 classes based on relative adherence to basic (modified) WHO and MoH recommendations for care attendance from pregnancy to postnatal period prior to 2016, that is, before the current WHO recommendation of 8 ANC visits. Since data for both countries were collected prior to the new WHO 2016 ANC recommendations, we used previous Focused ANC recommendations. A mother with a combination of 4 or more visits, health facility birth (skilled birth) and at least 1 PNC contact was classified in the *highest* category of care-seeking and those with

least/no amount of care were categorized as *lowest* class. The intermediate categories were classified on the basis of optimal and perceived descending-level of care-seeking behavior as *higher*, *high, moderately high, slightly high, moderately low, moderately lower, very low, 7th lowest, 6th lowest, 5th lowest, 4th lowest, 3rd lowest, 2nd lowest and lowest,* as shown in Table 1 below.

Table 1: Classification of continuum of care-seeking classes during antenatal period, childbirth and within 28 days postnatal period in Kenya and Uganda.

	≥ 4 ANC visits	2-3 ANC visits	1 ANC visit	0 ANC visit
Health facility births				
PNC - Yes	Highest	Higher	7th lowest	–
PNC - No	High	Moderate high	6th lowest	3rd lowest
Birth outside of health facility				
PNC - Yes	Slightly high	Moderately lower	5th lowest	2nd lowest
PNC - No	Moderately low	Very low	4th lowest	Lowest

ANC – Antenatal care, PNC – Postnatal care, 1st – first, 2nd – Second…

The first component of classification was in accordance with the number of ANC visits a mother had, the second level was on the basis of whether or not a mother delivered at the health facility and the last part of continuum of care was whether or not a mother had PNC visit within 28 days postpartum.

Neonatal mortality was a secondary outcome variable that was dichotomized into *`yes´* (died) and *`no´* (lived) depending on whether the neonate lived or not. The predictor variables for this outcome variable were the modified classes of care-seeking continuum discussed as the primary outcomes above.

Independent variables

These constituted sociodemographic factors and maternal characteristics that were examined across all care-seeking continuum categories of the primary outcome variable. They included variables that the modified Andersen and Newman behavioral model for care utilization identified as predictors of care-seeking behavior [19]. Further, the categorization of these variables was also informed by a number of maternal and child health studies previously conducted in SSA. They included *maternal age* which was initially grouped as 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49 years old and we recategorized it into 15–24, 25–34 and

35–49 years years old while *place of residence* remained as *rural* and *urban* [46]. *Marital status* was dichotomized into single or married [47]. A mother having a *problem with longer distance/transportation to nearest health facility* was classified as `yes´ if it was a problem and `no´ if it was not [48]. *Desire to have a newborn child, whether or not mother was told about pregnancy complications* [49] *and having exposure to mass media* [50] *were all categorized as ´yes´ and ´no´*. The variable *who ultimately makes maternal care-seeking decisions* was categorized as respondent (woman) alone, husband alone or joint decision [51]. *Education* was categorized as no education, primary education and secondary or higher [52]. *Parity* (number of children ever born) was categorized as primiparous (for first time mothers) para 2-3 (for those with 2-3 children) and para 4+ [46]. *Wealth status* was classified into poor (poor/poorest), middle and rich(rich/richest) [52, 53]. The wealth status in DHS is indexed based on household cumulative living standards taking into account assets possessed, water and sanitation facilities. Place of residence was classified into rural and urban [53].

Mapping the predictor – outcome relationship using directed acyclic graphs

Prior to the analysis, the directed acyclic graphs (DAGs) by Textor and colleagues [54] were used to map the predictors of both care-seeking behaviors and neonatal mortality on the basis of existing peer-reviewed evidence and to identify any confounding bias in our models. Supplementary file 2, Diagrams 1.a and b illustrate the process. For Diagram 1.b, the lower levels of care-seeking are represented by a lack of a care component(s) that is/are major non-causal risk factor for neonatal mortality.

Data analysis

We used cross-tabulations to examine the distribution of mothers across variables and variable categories in the different levels of care-seeking continuum. We also investigated correlations between ANC visits and proportions of health facility childbirths and PNC visits. Multinomial logistic regression models examined the associations between sociodemographic and maternal factors and continued care-seeking at different care-seeking classes/categories, with the *lowest* class as the reference group. The independent variables were mutually adjusted for each other.

Binary logistic regression was used to determine the odds ratios (OR) for the associations between the various classes of care-seeking continuum and neonatal mortality. For plausible and valid analysis, 9 classes with satisfactory data were used in the overall mortality analysis

with the *highest* class as the reference group. Low birthweight babies and multiple gestations are strong independent risk factors for neonatal death, [55, 56], thus were excluded in the mortality analysis to obtain adjusted OR. The rest of the classes were not used owing to fewer numbers in certain neonatal mortality strata. Similarly, country-specific analysis resulted into elimination of more strata with fewer numbers. Further, the resulting significant adjusted odds ratios were used to estimate attributable risk fraction (AR) and population attributable risk fraction (PAR) for both countries combined. This was to determine proportion of neonatal deaths that would be prevented if mothers in a given lower level of care-seeking continuum had sought care at the *highest* class. We used Stata version 16 (College Station, TX: Stata Press) and Microsoft Excel for analysis and to generate graphical summaries of results. Sampling weights were applied, and we accounted for complex sampling design recommended by the DHS methodology guide. Missing data due to nonresponse were mostly negligible compared to the sub-population samples sizes and relatively randomly spread across the variable subgroups; they were nevertheless omitted in our analysis. For the variable "Knowledge about pregnancy, birth complications" where data was missing for Uganda, the analysis was only performed for Kenya where plausible.

Estimating attributable neonatal mortality risk proportions associated with low levels of care-seeking continuum.

The attributable risk proportions (AR) and population attributable neonatal mortality risk proportion (PAR) were obtain by the formulas AR = $[(OR-1)/OR)] * 100$ and PAR = Pe * $[(OR-1)/OR)] * 100$ respectively, where OR is the statistically significant adjusted odds ratio associated with that care-seeking class and *Pe* is the proportion of the total mortalities in that given care-seeking class.

Patient and public involvement

Patients or the public were not involved in the design or recruitment and conduct or in reporting or dissemination plans of this study.

Results

Table 2 and Figure 1 indicate that over 95% of mothers had at least 1 ANC visit and about 56% had 4 or more ANC contacts in Kenya and Uganda. Of those who had 4 or more ANC visits, 73% gave birth at a health facility and about 41% had newborn PNC check-up within 28 days after birth as shown in Table 2.

Table 2: Distribution of mothers by continuum of care-seeking classes during antenatal period, childbirth and within 28 days postnatal in Kenya and Uganda, using demographic and health survey 2014-2016 data, N=24502.

	≥ 4 ANC visits, n=13888	2-3 ANC visits, n=8744	1 ANC visit, N=775	0 ANC visit, N=1095
Health facility births				
PNC - Yes	4961(35.7)	2355(26.9)	115	68(6.2)
PNC - No	5179(37.3)	2782(31.8)	213	106(9.6)
Birth outside of health facility				
PNC - Yes	752(5.4)	632(7.2)	63	121(11.1)
PNC - No	2996(21.6)	2975(34.0)	384	800(73.1)

ANC – Antenatal care, PNC – Postnatal care, 1st – first, 2nd – Second…

The scatter plot in Figure 2 shows a positive correlation between number of antenatal care visits and both proportions of facility births and PNC visits. Further, Figure 3 shows that a single early ANC visit in the 1st or 2nd trimester increased the likelihood of health facility childbirth as opposed to late ANC visit in the 3rd trimester.

Table 3 shows the distribution of maternal and sociodemographic characteristics by care-seeking behaviour from pregnancy to postnatal period. Majority (≥ 46%) of the mothers were between 25–34 years of age in all care-seeking categories. Overall, about 71% of the mothers lived in a rural setting and 37 % of all women had problems with distance to the nearest health facility. Roughly 30 % and 57% of those who had highest and lowest care-seeking tendencies respectively, indicated distance could be a hindrance to care-seeking. Slightly over half of all the mothers had primary education. About 40% of highest care-seekers had secondary or higher education while 60% of lowest care-seekers had no formal education. Similar trends were observed among their husbands/partners (education).

Table 3. Distribution of maternal and sociodemographic factors, by continuum of care-seeking classes combining antenatal care (ANC) visits, delivery and postnatal care (PNC) in Kenya and Uganda, using demographic and health survey 2014-2016 data.

	4 or more ANC visits, n=13888				**2-3 ANC visits, n=8744**				**1 ANC visits, n=775**				**0 ANC visit, n=1027**		
Variables	**Highest** *(facility birth & PNC).* *n* (%)	**High** (facility *birth, no PNC).* *n* (%)	**Slightly high** (*no facility birth, PNC).* *n* (%)	**Mod-low** *(no facility birth, no PNC).* n (%)	**Higher** *(facility birth, PNC).* *n (%)*	**Mod-high** *(facility birth, no PNC).* *n* (%)	**Mod-lower** *(no facility birth, PNC).* *n* (%)	**Very low** *(no facility birth, no PNC).* *n* (%)	**7th lowest** *(facility birth, PNC)* *n* (%)	**6th lowest** *(facility birth, no PNC)* *n* (%)	**5th lowest** *(no facility birth, PNC)* *n* (%)	**4th lowest** *(no facility birth, no PNC)* *n* (%)	**3rd lowest** *(facility birth, no PNC)* *n* (%)	**2nd lowest** *(no facility birth, PNC)* *n* (%)	**Lowest** *(no facility birth, no PNC)* *n* (%)
Maternal age (Years)															
15-24	1625 (32.8)	1680 (32.4)	213 (28.3)	815 (27.2)	832 (35.3)	1001 (36.0)	159 (25.2)	778 (26.2)	51 (44.4)	77 (36.2)	20 (31.8)	123 (32.0)	43 (40.6)	36 (29.7)	189 (23.6)
25-34	2406 (48.5)	2513 (48.5)	315 (46.6)	1410 (47.1)	1064 (45.2)	1240 (44.6)	303 (47.9)	1385 (46.6)	35 (30.4)	91 (42.7)	17 (27.0)	160 (41.7)	41 (38.7)	52 (43.0)	360 (45.0)
35-49	930 (18.7)	986 (19.1)	189 (25.1)	771 (25.7)	459 (19.5)	541 (19.4)	170 (26.9)	812 (27.3)	29 (25.2)	45 (21.1)	26 (41.2)	101 (26.3)	22 (20.7)	33 (27.3)	251 (31.4)
Place of residence															
Urban	1669 (33.6)	2096 (40.5)	164 (21.8)	483 (16.1)	677 (28.8)	956 (34.4)	122 (19.3)	409 (13.8)	30 (26.1)	79 (37.1)	14 (22.2)	52 (13.5)	33 (31.1)	18 (14.9)	85 (10.6)
Rural	3292 (66.4)	3083 (59.5)	588 (78.2)	2513 (83.9)	1678 (71.3)	1826 (65.6)	510 (80.7)	2566 (86.2)	85 (73.9)	134 (62.9)	49 (77.8)	332 (86.5)	73 (68.9)	103 (85.1)	715 (89.4)
Distance to nearest health facility is a big problem															
No	3490 (70.3)	1561 (66.5)	472 (62.8)	876 (52.3)	1580 (67.1)	810 (62.9)	379 (60.1)	862 (50.5)	74 (64.4)	60 (63.2)	36 (57.1)	97 (47.1)	34 (68)	62 (51.2)	148 (42.8)
Yes	1471 (29.7)	785 (33.5)	280 (37.2)	798 (47.7)	775 (32.9)	477 (37.1)	252 (39.9)	844 (49.5)	41 (35.6)	35 (36.8)	27 (42.9)	109 (52.9)	16 (32.0)	59 (48.8)	198 (57.2)
Maternal education level															
No education	435 (8.8)	389 (7.5)	167 (22.2)	811 (27.1)	241 (10.2)	271 (9.8)	140 (22.2)	726 (24.4)	15 (13.0)	42 (19.7)	18 (28.6)	139 (36.2)	20 (18.9)	63 (52.0)	486 (60.8)
Primary	2535 (51.1)	2721 (52.5)	486 (64.6)	1789 (59.7)	1369 (58.2)	1645 (59.1)	399 (63.1)	1960 (65.9)	73 (63.5)	124 (58.2)	37 (58.7)	218 (56.8)	57 (53.8)	52 (43.0)	280 (35.0)

Mod- Moderately.

	4 or more ANC visits, n=13888				2-3 ANC visits, n=8744				1 ANC visits, n=775				0 ANC visit, n=1027		
Variables	**Highest** *(facility birth & PNC). n* (%)	**High** (facility *birth, no PNC). n* (%)	**Slightly high** (*no facility birth, PNC). n* (%)	**Mod-low** *(no facility birth, no PNC).* n (%)	**Higher** *(facility birth, PNC). n (%)*	**Mod-high** *(facility birth, no PNC). n* (%)	**Mod-lower** *(no facility birth, PNC). n* (%)	**Very low** *(no facility birth, no PNC). n* (%)	**7th lowest** *(facility birth, PNC) n* (%)	**6th lowest** *(facility birth, no PNC) n* (%)	**5th lowest** *(no facility birth, PNC) n* (%)	**4th lowest** *(no facility birth, no PNC) n* (%)	**3rd lowest** *(facility birth, no PNC) n* (%)	**2nd lowest** *(no facility birth, PNC) n* (%)	**Lowest** *(no facility birth, no PNC) n* (%)
Secondary and higher	1991 (40.1)	2069 (40.0)	99 (13.2)	396 (13.2)	745 (31.6)	866 (31.1)	93 (14.7)	289 (9.7)	27 (23.5)	47 (22.1)	8 (12.7)	27 (7.0)	29 (27.3)	6 (5.0)	34 (4.3)
Partner/husband education level															
No education	255 (6.1)	128 (6.5)	118 (16.9)	276 (19.1)	142 (7.4)	68 (6.5)	98 (16.8)	259 (17.5)	7 (8.4)	17 (23.0)	13 (23.2)	39 (23.8)	4 (13.8)	52 (49.5)	173 (55.0)
Primary	1860 (44.6)	991 (50.3)	401 (57.5)	815 (56.5)	1011 (52.4)	590 (56.2)	348 (59.8)	938 (63.5)	46 (55.4)	39 (52.7)	32 (57.1)	96 (58.5)	19 (65.5)	43 (41.0)	109 (35.3)
Secondary & higher	2059 (49.3)	851 (43.2)	179 (25.6)	352 (24.4)	777 (40.2)	392 (37.3)	136 (23.4)	280 (19.0)	30 (36.1)	18 (24.3)	11 (19.6)	29 (17.7)	6 (20.7)	10 (9.5)	27 (8.7)
Knowledge about pregnancy, birth complications (only Kenya)															
No	537 (32.8)	319 (39.1)	348 (47.4)	286 (63.4)	341 (45.6)	250 (53.7)	349 (55.6)	351 (66.9)	29 (64.4)	23 (50.0)	44 (69.8)	63 (75.9)	–	–	–
Yes	1099 (67.2)	496 (60.9)	386 (52.6)	165 (36.6)	407 (54.4)	216 (46.3)	279 (44.4)	174 (33.1)	16 (35.6)	23 (50.0)	19 (30.2)	20 (24.1)	–	–	–
Desire to have a child,															
No	142 (8.7)	215 (9.2)	97 (12.9)	206 (12.3)	249 (10.6)	153 (11.9)	120 (19.0)	257 (15.1)	24 (20.9)	22 (23.2)	18 (28.6)	40 (19.4)	7 (14.0)	29 (24.0)	48 (13.9)
Yes	1496 (91.3)	2132 (90.8)	654 (87.1)	1469 (87.7)	2106 (89.4)	1133 (80.1)	512 (81.0)	1449 (84.9)	91 (79.1)	73 (76.8)	45 (71.4)	166 (80.6)	43 (86.0)	92 (76.0)	298 (86.1)
Who ultimately makes care-seeking decisions															
Respondent alone	1337 (32.7)	548 (28.6)	229 (36.6)	461 (32.2)	600 (31.9)	343 (33.0)	172 (33.0)	416 (28.9)	28 (34.2)	14 (19.4)	16 (36.4)	49 (30.2)	10 (35.7)	18 (22.2)	61 (20.7)

Mod- Moderately.

Variables	4 or more ANC visits, n=13888				2-3 ANC visits, n=8744				1 ANC visits, n=775				0 ANC visit, n=1027		
	Highest *(facility birth & PNC).* *n* (%)	**High** (facility *birth, no PNC).* *n* (%)	**Slightly high** (*no facility birth, PNC).* *n* (%)	**Mod-low** *(no facility birth, no PNC).* n (%)	**Higher** *(facility birth, PNC).* *n (%)*	**Mod-high** *(facility birth, no PNC).* *n* (%)	**Mod-lower** *(no facility birth, PNC).* *n* (%)	**Very low** *(no facility birth, no PNC).* *n* (%)	**7th lowest** *(facility birth, PNC)* *n* (%)	**6th lowest** *(facility birth, no PNC)* *n* (%)	**5th lowest** *(no facility birth, PNC)* *n* (%)	**4th lowest** *(no facility birth, no PNC)* *n* (%)	**3rd lowest** *(facility birth, no PNC)* *n* (%)	**2nd lowest** *(no facility birth, PNC)* *n* (%)	**Lowest** *(no facility birth, no PNC)* *n* (%)
Both	1776 (43.5)	834 (43.4)	236 (37.8)	600 (41.9)	834 (44.3)	437 (42.1)	186 (35.7)	612 (42.4)	32 (39.0)	36 (50.0)	13 (29.6)	56 (34.6)	8 (28.6)	31 (38.3)	134 (45.6)
Husband alone	973 (23.8)	537 (28.0)	160 (25.0)	370 (25.9)	448 (23.8)	258 (24.9)	163 (31.3)	414 (28.7)	22 (26.8)	22 (30.6)	15 (34.1)	57 (35.2)	10 (35.7)	32 (39.5)	99 (33.7)
Parity															
Primiparous	1293 (26.1)	1388 (26.8)	96 (12.8)	324 (10.8)	555 (23.6)	715 (25.7)	68 (10.8)	295 (9.9)	32 (27.8)	53 (24.9)	10 (15.9)	53 (13.8)	28 (26.4)	13 (10.7)	98 (12.3)
Para 2-3	1877 (37.8)	2113 (40.8)	287 (38.2)	988 (33.0)	855 (36.3)	1061 (38.1)	219 (34.7)	906 (30.5)	28 (24.4)	72 (33.8)	16 (25.4)	108 (28.1)	33 (31.1)	36 (29.8)	200 (25.0)
Para 4+	1791 (36.1)	1678 (32.4)	369 (49.0)	1684 (56.2)	945 (40.1)	1006 (36.2)	345 (54.6)	1774 (59.6)	55 (47.8)	88 (41.3)	37 (58.7)	223 (58.1)	45 (42.5)	72 (59.5)	502 (62.7)
Wealth status															
Poor	1785 (36.0)	1739 (33.6)	497 (66.1)	1953 (65.2)	994 (42.2)	1181 (42.5)	446 (70.6)	2108 (70.9)	52 (45.2)	106 (49.8)	50 (47.2)	285 (74.2)	43 (68.3)	103 (85.1)	684 (85.5)
Middle	854 (17.2)	1031 (19.9)	132 (17.6)	556 (18.5)	457 (19.4)	565 (20.3)	127 (20.1)	498 (16.7)	24 (20.9)	44 (20.7)	20 (18.9)	60 (15.6)	10 (15.9)	15 (12.4)	51 (6.4)
Rich	2322 (46.8)	2409 (46.5)	123 (16.4)	487 (16.3)	904 (38.4)	1036 (37.2)	59 (9.3)	369 (12.4)	39 (33.9)	63 (29.6)	36 (34.9)	39 (10.29	10 (15.9)	3 (2.5)	65 (8.1)
Marital status															
Single	859 (17.3)	880 (17.0)	123 (16.4)	435 (14.5)	464 (19.7)	403 (20.6)	109 (17.3)	458 (15.4)	33 (28.7)	55 (25.8)	19 (30.2)	90 (23.4)	38 (35.9)	39 (32.2)	123 (15.4)
Married	4102 (82.7)	4299 (83.0)	629 (83.6)	2561 (85.5)	1891 (80.3)	1558 (79.5)	523 (82.7)	2517 (84.6)	82 (72.3)	158 (74.2)	44 (69.8)	294 (76.6)	68 (64.1)	82 (67.8)	677 (84.6)
Mass media exposure															

Mod- Moderately.

	4 or more ANC visits, n=13888				2-3 ANC visits, n=8744				1 ANC visits, n=775				0 ANC visit, n=1027		
Variables	**Highest** *(facility birth & PNC). n* (%)	**High** (facility *birth, no PNC). n* (%)	**Slightly high** (*no facility birth, PNC). n* (%)	**Mod-low** *(no facility birth, no PNC).* n (%)	**Higher** *(facility birth, PNC). n (%)*	**Mod-high** *(facility birth, no PNC). n* (%)	**Mod-lower** *(no facility birth, PNC). n* (%)	**Very low** *(no facility birth, no PNC). n* (%)	**7th lowest** *(facility birth, PNC) n* (%)	**6th lowest** *(facility birth, no PNC) n* (%)	**5th lowest** *(no facility birth, PNC) n* (%)	**4th lowest** *(no facility birth, no PNC) n* (%)	**3rd lowest** *(facility birth, no PNC) n* (%)	**2nd lowest** *(no facility birth, PNC) n* (%)	**Lowest** *(no facility birth, no PNC) n* (%)
No	804 (16.2)	484 (20.6)	733 (14.1)	521 (18.7)	204 (27.1)	993 (33.2)	176 (27.9)	1105 (37.1)	26 (22.6)	56 (26.3)	17 (27.0)	170 (44.3)	27 (25.5)	61 (50.4)	508 (36.6)
Yes	4157 (83.8)	1871 (79.4)	4446 (85.9)	2261 (81.3)	548 (72.9)	2001 (66.8)	456 (72.1)	1870 (62.9)	89 (77.4)	157 (72.7)	46 (73.0)	214 (55.7)	79 (74.5)	60 (49.6)	291 (36.4)
Mod- Moderately															

Table 4 shows the results of the multinomial regressions for the associations between independent factors and different classes of care-seeking continuum from pregnancy to childbirth and 28 days postnatal, *lowest* class being reference category. Maternal primary or higher education levels compared to no formal education, were significantly associated with higher care-seeking behaviour in almost all care-seeking categories except among those who had 1 ANC visit/facility birth/no PNC *(6th lowest)* or less; relative risk ratios RRRs ranged from 2.1– 8.0, (95% confidence intervals [95% CI] 1.1–16.3). Similarly, trends were observed among those with husbands having primary education and above; RRRs ranged from 2.1– 6.4 (95% CI 1.3–10.6). Generally, the higher the level of education, the higher the care-seeking tendency. Exposure to mass media (radio/television) was generally associated with higher care-seeking tendency; RRRs ranged from 1.8– 3.2 (95% CI 1.2–5.4). There was minimal indication that desire to have a child improves care-seeking, although high RRR to seek care were observed among those who had 2 or more ANC visits, but findings were not statistically significant except in the *high* category.

Problem with distance to the health facility (versus no problem) was largely a demotivating factor to care-seeking. In 6 care-seeking categories, the RRRs ranged from 0.6 – 0.7 (95% CI 0.5–0.9), whereas in the remaining categories, *very low* to *lowest*, the association was marginally not statistically significant; RRRs ranged from 0.6 – 1.1 (95% CI 0.3–1.4). Higher parity versus primiparous was not associated with care-seeking except in a few care-seeking categories among those who had 2–3 ANC visits. Generally, being told about pregnancy and birth complications significantly increased the tendency to seek care in Kenya.

Older maternal age compared to young age was generally not significantly associated with care-seeking at all levels of care-seeking continuum, RRRs ranged from 0.4 – 0.9 (95% CI 0.3–1.7), except marginally significant in *moderately high* and *7th lowest* classes. Living in a rural area versus urban was significantly associated with lower care-seeking tendency in 9 categories. The remaining care-seeking categories indicated lower tendency but not significant results. Care-seeking was also notably hindered when the husband/partner rather than the woman made major decisions for maternal care-seeking in about 9 care-seeking categories. Being married showed variably and inconsistent associations with care-seeking, in most care-seeking classes, there was no significant association with care-seeking when compared to single mothers. Compared to the poor, the middle wealth status only showed significant higher care-seeking tendency in the first 4 higher care-seeking classes and 2 other

random classes, the rest were not statistically significant. Additionally, being rich indicated almost no significant association with care-seeking. Figure 4 summarizes in a forest plot, selected (extremes) results from table 4.

Table 4: Multinomial logistic regression showing relative risk ratios (RRR) for the associations between maternal and socio-demographic factors and maternal continuum of care-seeking behaviour in Kenya and Uganda, using demographic and health survey 2014-2016 data.

Variables	**Highest** *(≥4 ANC visits, facility birth & PNC).*	**Higher** *(2-3 ANC visits, facility birth, PNC).*	**High** (*≥4 ANC visits,* facility *birth, no PNC).*	**Mod-high** *(2-3 ANC visits, facility birth, no PNC).*	**Slightly high** (*≥4 ANC visits, no facility birth, PNC).*	**Mod-low** *(≥4 ANC visits, no facility birth, no PNC).*	**Mod-lower** *(2-3 ANC visits, no facility birth, PNC).*	**Very low** *(2-3 ANC visits, no facility birth, no PNC).*	**7th lowest** *(1 ANC visit, facility birth, PNC)*	**6th lowest** *(1 ANC visit, facility birth, no PNC)*	**5th lowest** *(1 ANC visit, no facility birth, PNC)*	**4th lowest** *(1 ANC visit, no facility birth, no PNC)*	**3rd lowest** *(No ANC visit, facility birth, no PNC)*	**2nd lowest** *(No ANC visits, no facility birth, PNC)*
Versus *lowest* (*no ANC, no facility birth, no PNC)* care-seeking level, 95% Confidence Interval (95%CI)														
Maternal education level														
No education	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Primary	3.2 (2.3-4.4)	3.2 (2.2,4.6)	3.4 (2.4-4.9)	2.7 (1.9-4.0)	2.1 (1.5-3.1)	2.3 (1.6-3.2)	2.1 (1.5-3.2)	2.8 (2.0-4.0)	2.6 (1.2-5.7)	1.5 (0.7-3.0)	1.7 (0.8-3.8)	1.7 (1.0-2.8)	2.6 (0.8-9.0)	0.9 (0.5-1.6)
Secondary & higher	8.0 (4.0-16.3)	6.9 (3.3-14.1)	6.9 (3.4,14.2)	4.9 (2.3-10.2)	2.5 (1.2-5.4)	3.1 (1.5-6.4)	3.9 (1.8-8.4)	2.9 (1.7-4.9)	3.4 (1.1-10.7)	1.7 (0.5-5.4)	2.1 (0.6-8.2)	1.5 (0.5-4.1)	4.3 (0.8,23.0)	0.6 (0.1-2.9)
Partner/husband education level														
No education	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Primary	3.3 (2.4-4.7)	3.4 (2.4-5.0)	3.6 (2.5-5.3)	4.7 (3.1-7.1)	2.6 (1.8-3.9)	2.1 (1.5-3.1)	2.7 (1.8-4.0)	2.7 (1.9-3.8)	3.4 (1.3-8.7)	1.9 (0.9-4.1)	1.9 (0.8-4.4)	2.5 (1.5-4.4)	–	1.2 (0.7-2.2)
Secondary & higher	6.4 (3.8-10.6)	5.5 (3.2-9.2)	6.2 (3.7-10.6)	7.2 (4.1-12.7)	3.7 (2.1-6.5)	3.0 (1.8-5.1)	3.4 (1.9-6.0)	2.9 (1.7-4.9)	6.0 (2.1-17.4)	2.3 (0.9-6.1)	2.1 (0.7-6.3)	3.3 (1.5-6.9)	–	1.2 (0.5-3.0)
Distance to nearest health facility is a big problem														
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	0.6 (0.5-0.8)	0.6 (0.5-0.8)	0.7 (0.5-0.9)	0.7 (0.5-0.9)	0.6 (0.5-0.8)	0.8 (0.6-1.0)	0.7 (0.5-0.9)	0.8 (0.6-1.1)	0.7 (0.4-1.2)	0.6 (0.3-1.0)	0.7 (0.4-1.3)	1.1 (0.7-1.6	0.6 (0.3-1.4)	0.8 (0.5-1.3)
Desire to have a child,														
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Mod- Moderately. Predictor variables mutually adjusted for each other.														

Variables	**Highest** *(≥4 ANC visits, facility birth & PNC).*	**Higher** *(2-3 ANC visits, facility birth, PNC).*	**High** (≥4 *ANC visits,* facility *birth, no PNC).*	**Mod-high** *(2-3 ANC visits, facility birth, no PNC).*	**Slightly high** (≥4 *ANC visits, no facility birth, PNC).*	**Mod-low** *(≥4 ANC visits, no facility birth, no PNC).*	**Mod-lower** *(2-3 ANC visits, no facility birth, PNC).*	**Very low** *(2-3 ANC visits, no facility birth, no PNC).*	**7th lowest** *(1 ANC visit, facility birth, PNC)*	**6th lowest** *(1 ANC visit, facility birth, no PNC)*	**5th lowest** *(1 ANC visit, no facility birth, PNC)*	**4th lowest** *(1 ANC visit, no facility birth, no PNC)*	**3rd lowest** *(No ANC visit, facility birth, no PNC)*	**2nd lowest** *(No ANC visits, no facility birth, PNC)*
Versus *lowest* (*no ANC, no facility birth, no PNC)* care-seeking level, 95% Confidence Interval (95%CI)														
Yes	1.5 (1.0-2.2)	1.3 (0.9-2.0)	1.6 (1.1-2.4)	1.2 (0.8-1.8)	1.3 (0.8-2.0)	1.4 (1.0-2.2)	0.9 (0.5-1.3)	1.3 (0.9-2.0)	0.7 (0.3-1.4)	0.8 (0.4-1.7)	0.5 (0.2-1.2)	1.0 (0.6-1.8)	0.5 (0.2-1.7)	0.4 (0.2-0.7)
Mass media exposure														
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	3.2 (2.4-4.2)	2.7 (2.0-3.6)	2.7 (2.0-3.6)	2.7 (2.0-3.7)	3.0 (2.2-4.1)	2.1 (1.6-2.8)	3.0 (2.2-4.2)	1.8 (1.4-2.4)	2.9 (1.6-5.4)	1.6 (0.9-3.0)	3.2 (1.6-6.3)	1.5 (1.0-2.4)	2.0 (0.8-4.8)	2.0 (1.2-3.2)
Told about pregnancy, birth complications (only Kenya) Versus *very low* care-seeking level														
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	–	–	–	–	–	–	–
Yes	2.6 (2.0-3.2)	1.7 (1.3-2.2)	2.1 (1.7-2.8)	1.1 (1.0-1.7)	2.0 (1.6-2.5)	1.2 (0.9-1.6)	1.5 (1.2-1.9)	–	–	–	–	–	–	–
Who ultimately makes care-seeking decisions														
Respond-ent alone	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Both	0.5 (0.4-0.8)	0.6 (0.4-0.8)	0.6 (0.4-0.9)	0.5 (0.4-0.8)	0.5 (0.3-0.7)	0.5 (0.4-0.8)	0.5 (0.3-0.7)	0.7 (0.5-0.9)	0.5 (0.3-0.9)	1.3 (0.6-2.5)	0.4 (0.2-0.9)	0.5 (0.3-0.9)	0.4 (0.1-1.0)	0.9 (0.5-1.7)
Husband alone	0.5 (0.4-0.7)	0.5 (0.4-0.7)	0.7 (0.5-0.9)	0.5 (0.3-0.7)	0.5 (0.3-0.7)	0.5 (0.3-0.7)	0.7 (0.4-1.0)	0.7 (0.5-0.9)	0.5 (0.3-1.0)	1.1 (0.5-2.5)	0.6 (0.3-1.4)	0.7 (0.4-1.2)	0.7 (0.3-1.8)	1.1 (0.6-2.2)
Maternal age (Years)														
15-24	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
25-34	0.9 (0.6-1.3)	0.7 (0.5-1.1)	0.6 (0.4-1.0)	0.6 (0.4-0.9)	0.9 (0.5-1.3)	0.6 (0.4-0.9)	0.9 (0.6-1.5)	0.6 (0.4-1.0)	0.4 (0.2-0.8)	0.8 (0.3-1.7)	0.4 (0.2-1.2)	0.5 (0.3-0.9)	0.5 (0.2-1.3)	0.5 (0.1-1.0)
35-49	0.8 0.5-1.3	0.6 (0.4-1.1)	0.6 (0.4-1.0)	0.5 (0.3-0.8)	0.9 (0.5-1.5)	0.5 (0.3-0.8)	0.8 (0.5-1.5)	0.6 (0.4-1.1)	0.4 (0.1-0.9)	0.9 (0.3-2.4)	0.8 (0.3-2.3)	0.6 (0.3-1.2)	0.3 (0.1-1.4)	0.3 (0.1-0.7)
Place of residence														

Mod- Moderately. Predictor variables mutually adjusted for each other

Variables	**Highest** *(≥4 ANC visits, facility birth & PNC).*	**Higher** *(2-3 ANC visits, facility birth, PNC).*	**High** *(≥4 ANC visits,* facility *birth, no PNC).*	**Mod-high** *(2-3 ANC visits, facility birth, no PNC).*	**Slightly high** *(≥4 ANC visits, no facility birth, PNC).*	**Mod-low** *(≥4 ANC visits, no facility birth, no PNC).*	**Mod-lower** *(2-3 ANC visits, no facility birth, PNC).*	**Very low** *(2-3 ANC visits, no facility birth, no PNC).*	**7th lowest** *(1 ANC visit, facility birth, PNC)*	**6th lowest** *(1 ANC visit, facility birth, no PNC)*	**5th lowest** *(1 ANC visit, no facility birth, PNC)*	**4th lowest** *(1 ANC visit, no facility birth, no PNC)*	**3rd lowest** *(No ANC visit, facility birth, no PNC)*	**2nd lowest** *(No ANC visits, no facility birth, PNC)*
Versus *lowest* (*no ANC, no facility birth, no PNC)* care-seeking level, 95% Confidence Interval (95%CI)														
Urban	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Rural	0.4 (0.2-0.6)	0.4 (0.2-0.6)	0.3 (0.2-0.5)	0.4 (0.3-0.7)	0.4 (0.2-0.6)	0.7 (0.4-1.1)	0.4 (0.2-0.6)	0.7 (0.4-1.1)	0.3 (0.2-0.7)	0.2 (0.1-0.4)	0.4 (0.2-1.0)	0.6 (0.3-1.2)	0.5 (0.2-1.5)	0.4 (0.2-0.8)
Marital status														
Single	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Married	1.9 (1.1-3.3)	1.7 (1.0-3.0)	2.0 (1.2-3.5)	2.0 (1.1-3.7)	0.6 (0.3-1.0)	2.4 (1.3-4.3)	0.5 (0.3-1.0)	1.6 (0.9-2.8)	1.5 (0.5-4.5)	1.9 (0.6-6.9)	0.3 (0.1-0.6)	1.9 (0.7-5.3)	1.0 (0.2-4.5)	0.2 (0.1-0.5)
Wealth status														
Poor	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Middle	1.8 (1.1-3.0)	2.0 (1.2-3.3)	2.2 (1.3-3.6)	1.9 (1.1-3.2)	1.3 (0.8-2.2)	1.9 (1.2-3.2)	1.3 (0.8-2.2)	1.5 (0.9-2.6)	2.7 (1.3-5.6)	2.6 (1.2-5.9)	1.4 (0.6-3.3)	1.8 (0.9-3.4)	1.7 (0.5-5.4)	0.9 (0.4-2.1)
Rich	1.3 (0.8-2.0)	1.2 (0.7-1.8)	1.2 (0.8-1.9)	1.1 (0.7-1.8)	0.4 (0.2-0.7)	0.8 (0.5-1.3)	0.2 (0.1-0.3)	0.6 (0.4-0.9)	1.1 (1.5-2.4)	1.3 (0.6-2.9)	0.3 (0.1-1.1)	0.4 (0.2-0.9)	1.2 (0.4-3.6)	0.1 (0.0-0.4)
Parity														
Primiparous	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Para 2-3	0.9 (0.6-1.5)	1.1 (0.6-1.8)	1.1 (0.6-1.7)	1.1 (0.6-1.8)	1.6 (0.9-2.8)	1.7 (1.0-2.9)	2.0 (1.1-3.6)	1.9 (1.1-3.2)	1.1 (0.5.2.7)	0.9 (0.3-2.3)	0.9 (0.3-2.6)	1.5 (0.7-3.3)	1.9 (0.5-6.8)	2.7 (1.0-7.6)
Para 4+	0.7 (0.4-1.2)	0.9 (0.5-1.6)	0.9 (0.5-1.6)	1.1 (0.6-1.9)	2.2 (0.6-2.2)	2.3 (1.3-4.0)	1.6 (0.8-3.1)	2.5 (1.4-4.5)	1.9 (0.7-5.2)	0.9 (0.3-2.7)	0.9 (0.3-3.1)	2.1 (0.9-5.1)	1.0 (0.2-4.9)	2.8 (0.9-8.4)
Mod- Moderately. Predictor variables mutually adjusted for each other														

Table 5 presents the odds ratios for the associations between continued care-seeking categories and neonatal mortality, with the *highest* category as the reference class. Figure 5 shows a forest plot of adjusted odds ratios (aOR) for overall results in Table 5. Overall, *3rd lowest* and *lowest* categories were associated with about 4-folds odds of neonatal mortality, aOR 4.2, (95% CI_{range} 1.6–10.9). For joint Kenya and Uganda, *moderately high and very low* levels of care-seeking also showed significant higher odds of neonatal death; aOR ranged 1.9 – 2.4 for the two classes. However, the remaining two categories *(4^{th} lowest and moderately low)* did not indicate any statistically significant association with mortality. For Kenya only, *lowest*, *very low, moderately low, moderately high,* and *high* versus *highest* were all significantly associated with neonatal deaths and neonates in the *lowest* class were 6 times likely to die. For Uganda, only *very low* category was significantly associated with neonatal death, aOR 1.7 (95% CI 1.1-2.7) and *lowest* class showed higher odds but was marginally not significant aOR 2.5 (95% CI 1.0-6.0). We observe that the proportion of Ugandan mothers seeking continued care at highest level were more than twice (33.8%) that of Kenya (13.4%)

Table 5: Crude and adjusted odds ratios for the association between classes of care-seeking behavior in continuum of care and neonatal mortality in Kenya and Uganda, using demographic and health survey 2014-2016 data.

Classes of care-seeking behaviour	Overall Crude odds ratio (95% CI) n=22538	Overall aOR* (95% CI)	Proportion of the total in Kenya (%) n=12579	Kenya only aOR* (95% CI)	Proport-ion of the total in Uganda (%) n=9959	Uganda only aOR* (95% CI)
Highest *(≥4 ANC visits, health facility birth, yes PNC).*	Ref.	Ref.	(13.4)	Ref.	(33.8)	Ref.
Higher *(2-3 ANC visits, Health facility birth, yes PNC). Mis=47*	1.5 (1.0-2.4)	1.3 (0.7-2.2)	(6.1)	1.4 (0.4-4.2)	(16.3)	0.9 (0.5-1.5)
High *(≥4 ANC visits, Health facility birth, no PNC). Mis=72*	1.5 (1.0-2.2)	1.5 (1.0-2.3)	(29.8)	2.9 (1.4-6.0)	(15.6)	1.0 (0.6-1.7)
Moderately high *(2-3 ANC visits, health facility birth and no PNC). Mis=33*	2.4 (1.6-3.7)	2.2 (1.4-3.4)	(16.0)	3.4 (1.6-7.4)	(8.4)	1.6 (0.9-2.7)
Moderately low *(≥4 ANC visits, no facility birth, no PNC). Mis=44*	1.3 (0.8-2.1)	1.3 (0.8-2.2)	(14.5)	2.6 (1.2-5.9)	(12.4)	0.8 (0.4-1.4)
Very low *(2-3 ANC visits, no facility birth, no PNC). Mis=48*	1.9 (1.3-2.8)	1.9 (1.3-2.9)	(14.7)	2.8 (1.3-6.2)	(12.0)	1.7 (1.1-2.7)
4^{th} lowest *(1 ANC visit, no health facility births, no PNC) Mis=2*	2.2 (0.7-6.7)	2.2 (0.7-7.3)	(2.1)	–	(1.2)	–
3^{rd} lowest *(No ANC, health facility births and no PNC). Mis=2*	7.8 (3.5-17.5)	4.2 (1.6-10.9)	(0.5)	–	(0.4)	–
Lowest *(No ANC, no facility births and no PNC.). Mis=17*	4.5 (2.5-7.8)	4.2 (2.3-7.8)	(5.6)	6.0 (2.6-13.6)	(1.5)	2.5 (1.0-6.5)

*adjusted/restricted to birthweight ≥ 2500 g and singleton births. *Mis – Missing: Due to non-response, proportionally(relatively random) distributed across all strata.*

Still in Table 5, in combined country findings, comparing *higher* and *moderately high* classes both with 2-3 ANC visits and facility childbirth, the only difference is lack of PNC attendance in the *moderately high* class indicating that lack of PNC contributes significantly to neonatal deaths, aOR 2.2 (95% CI 1.4-3.4). Similarly, in Kenya with 16% of mothers in this (*moderately high)* category, aOR 3.4 (95% CI 1.6-7.4). In Uganda only about 8% of mothers were in this category. It can generally be observed that care-seeking tendencies are higher in Uganda compared to Kenya, with mothers seeking care at *highest* level more than doubles that of Kenya (33.8% versus 13.4%). Similarly, at *lowest* level Uganda is more than thrice lower than Kenya (1.5% versus 5.6%)

Figure 6 below shows that overall, for both Kenya and Uganda, 23% neonatal deaths were attributable to inadequate maternal care-seeking during pregnancy, childbirth and 28 days postnatal period in the Kenya and Uganda. Insufficient care seeking within *lowest* and *3rd lowest* care-seekers accounted for almost 3-quarters (75%) of neonatal deaths in those groups. About 9% of neonatal deaths in Kenya and Uganda could be attributable to home births, no PNC visits and inadequate ANC visits.

Discussion

Although 95% of mothers initiated the first ANC visit in Kenya and Uganda, only about 20% completed recommended (modified) care attendance of 4 or more ANC visits, health facility birth and at least 1 PNC visit within 28 days after birth. Despite the relatively free or subsidized maternity costs in first level facilities in Uganda and Kenya, several factors still exert profound influence on care-seeking behaviour along the continuum of care that consequently impact neonatal survival. Overall, being educated indicated the highest odds of continual care-seeking, and parental education was 2–8 times associated with continued care-seeking in most of the care-seeking categories. The higher the education level, the higher tendency to seek care. Our results concur with other studies that have shown associations between education and uptake of ANC [57, 58], institutional birth [57, 59] and PNC [60]. Further, consistent with our findings, studies have reported higher utilization of obstetric care among mothers exposed to mass media [61]. Being told of pregnancy complications also improved care-seeking (in Kenya). Over 23% of neonatal deaths in Kenya and Uganda would be prevented if mothers adhered to recommended care attendance. Desire to have a child, parity and being married did not show any consistent associations with continued care-

seeking behaviour. Advance maternal age indicated lower tendency to seek care, but the findings were not statistically significant.

Conversely, a husband as the main or joint decision maker concerning maternal health care-seeking was generally a significant demotivating factors to care-seeking among the women in Kenya and Uganda. Although our study could not examine this further, other studies have shown that gender inequality, negative sociocultural factors and women's financial marginalization tend to hinder women´s independent decision making in health care especially in low-and middle-income settings [62, 63]. Over 80% of the mothers in this study were married and over 70% lived in rural areas, meaning most women are housewives with subsistence farming as source of livelihood. Thus maternal dependency on the husbands to seek care revolves mainly around financial support for repeated transportation and minor hospital expenses and this can hinder a woman´s decision to seek care. This partly explains why being married did not indicate consistent significance to care-seeking.

Also, congruent with our findings, a systematic review in Africa by Dahab et al. reported lack of women autonomy in health decisions as major hindrance to maternity care-seeking [64]. However, a study in Nepal, a similar social setting reported that a complex balance between women´s independence in maternity decision making and husband´s involvement can enhance maternity care-seeking [65]. Living in rural compared to urban and longer distance to the nearest health facility largely indicated lower tendency to care-seeking, this was especially true (significant) among relatively high care-seeking classes. However, the associations were not statistically significant among mostly lower care-seekers. In agreement with most of our findings, two systematic reviews also found longer distance to health facility [64] and rural residency [58] as factors that impede care-seeking. Being rich did not show any significant association with higher tendency to seek care as would be expected, however, the use of cumulative living standard and assets possessed to determine wealth status does not translate to having liquid cash, readily available to support care-seeking. Further research on a valid method to determine wealth status that incorporates monetary availability could be explored.

The far-reaching impacts of maternal and sociodemographic factors on maternal care-seeking continuum necessitate both short and long-term solutions with overarching implications for policy improvements. The 2030 Sustainable Development Goals (SDG) 4, 5 and 10 that

focus on inclusive education and gender equality and reducing inequalities resonate closely with most of the recommendations emanating from our findings. In the long-term, strengthening education for all with purposeful emphasis on maternity care-seeking should be integrated into the educational curriculum. A recent systematic review in SSA recommended female education as a strong enabling factor for ANC visits [20]. Improving knowledge and skills for all will inculcate women-led maternal health-decision making and create a supportive social environment that would enhance completion of the care-seeking continuum. In the short-term, health promotion for maternal care seeking among pregnant or nursing mothers will improve utilization and consequently greater neonatal survival.

The positive correlations between ANC and facility birth and PNC found in figure 2 indicate that even the first contact with health personnel can improve continued care utilization and these findings concur with other studies [66, 67]. The *3rd lowest* and *lowest* categories with no ANC, no PNC and only facility birth in the *3rd lowest* accounted for 76% of within-category neonatal deaths each, and a total of 7.0% deaths in the total population. Even though these two *lowest* categories had the highest within-category attributable mortality risks, they contributed relatively lower population attributable deaths partly because there were rather fewer mothers in these categories. In comparison, the mothers in the *very low* and *moderately high* categories with 2-3 ANC visits, no PNC plus facility birth only in the *moderately high* class accounted for relatively lower within-category deaths each (50%), however they accounted for more neonatal deaths in Kenya/Uganda population (16%) since relatively more mothers were in this category.

Given the findings in Figure 5, the results of the first 3 care-seeking classes *(higher, high, moderately high)* and last 2 classes *(3rd lowest, lowest)* seem to corroborate theoretical expectations in the `hierarchy´ of consequences of inadequate care-seeking. However, the odds for neonatal mortality in class 4 *(moderately low)* and class 6 *(4th lowest)* were not statistically significant for neonatal deaths as would be expected. Notably, in table 5, the *moderately low* with ≥ 4 ANC visits and no facility birth and no PNC showed significant association with neonatal death in Kenya but not Uganda. A possible explanation would be that the quality of ANC given in Uganda was perhaps better and protective than in Kenya. We could not deduce any possible explanations from our findings for why the odds ratio in

the *4th lowest* compared to the *highest* class was not statistical significance despite the low level of care received.

Further, in table 5, the only difference in care-seeking between *higher* and *moderately high* categories (versus *highest* class) *is* lack of PNC in the latter class. Thus, the statistical significance in the odds for mortality in the *moderately high* class and not in the *higher* class reveal that PNC could be very protective and is critical for neonatal survival. Our findings show that PNC is the least attended-to component of care continuum. WHO and other studies also agree that PNC is a crucial phase yet most neglected part of care [68, 69]. We recommend strategies that enhance PNC utilization in Kenya and Uganda. One such strategy would be to emphasize PNC right from the first ANC contact, which has not been the case. PNC attendance existed only in the checklists for fourth ANC visit in the focused ANC recommendations in both Kenya and Uganda [70, 71]. This implied that majority of mothers with less than 4 ANC visits got very limited information that could induce PNC attendance. The current WHO guidelines for 8 ANC visits recommends emphasis on continuity of care including PNC, however it is not clear on how PNC utilization would be promoted during ANC visits in non-midwife-led continuity of care models such as Kenya and Uganda and other LMIC if it is not clearly specified [72]. The twice higher proportion of Uganda women in the *highest* category than Kenya could be attributable to the fact that Uganda abolition of user fees in 2001 took place much earlier than in Kenya (2013).

Although it was not possible for our study to determine attributable mortality risks for each specific care component, nonetheless, we can deduce that over 23 % of neonatal deaths in Kenya and Uganda could be avoided through basic maternal and newborn care recommendations prior to 2016. We can also reason that if Kenya and Uganda would fully implement the current WHO recommendations of 8 ANC visits, it would lead to higher rates of facility births and ensure PNC as indicated in figure 2, then much higher proportions of neonatal deaths would be eliminated.

For mothers with problems with distance to the nearest health facility, strengthening, structuring, and funding the community health workers strategy to engage families, community and health facilities could help align care-seeking continuum especially for PNC that is currently poorly attended. The Village health workers (VHTs)in parts of Uganda for example have achieved profound improvement in promoting maternal care-seeking [73].

However, high attrition rate is a major challenge to community health workers (CHW) programs such as VHTs in Uganda due to poor governmental support (74). Given the readily available telephone communication in East Arica, the integration of mobile health or mHealth programme specifically for maternal care-seeking in the existing mHealth structure in Kenya [75] and Uganda [76] is another viable approach. A cost-free two-way mHealth messaging approach could facilitate follow up, counter sociodemographic barriers, and profoundly improve continued care-seeking. Engaging the CHW in this endeavor would be feasible with minimal extra investment.

Studies in Kenya and Uganda reported increased utilization of ANC and delivery services due to free maternity policy [77-79]. Reports evaluating impacts of free maternity policies in Kenya and Uganda highlight increase of ANC coverage and health facility births but almost no mention is made of the impact on PNC [40, 80]. Other studies have reported that free maternity policy increased mainly facility births [81, 82]. The universal health policy in Uganda and the *Linda mama* strategy [83] in Kenya advocate for universal access to quality maternity health services but do not offer transportation for poor mothers or health providers in/to remote areas, yet most mothers are rural dwellers. Additionally, there are hidden hospital charges due to underfunding or delayed distribution of funds [39, 41, 43].

Another worthwhile strategy to improve continued maternity care utilization among mothers would be to develop a standard questionnaire or a protocol for estimating the level of continued care-seeking based on a brief interview of the mother at first ANC visit. The results could be used to determine the degree of follow-up that can be employed to close the care-seeking gap. Such questionnaires have previously been used in to assess health seeking behaviour in sexual transmitted diseases for example [84]. It could be based on identified cluster of items including sociodemographic factors that impact care-seeking behaviours that after prolonged testing and validation could be shortened using factor analysis. Previous maternity history of care-seeking continuum could also be used to improve such a standard. Poor care-seeking mothers can then be enrolled in a messaging list or maternity mHealth programme. This can be a less-costly health promotion strategy that could easily be integrated in ANC setup in low-resourced health care settings.

Methodological considerations

The large sample size of the maternal and child data of the latest Kenya and Uganda DHS, which are nationally representative allowed for valid stratified analysis for deeper understanding of neonatal health and survival. The study is thus externally valid and generalizable in other similar settings. Like many cross-sectional surveys, recall bias may not be completely eliminated from the study. Nonetheless, by selecting the most recent live births for analysis and because childbirth is a special occurrence that mothers may not easily forget within a short period of time, our findings considerably reflect the reality of maternal care and associated neonatal survival in these countries.

A strength to our study was the use of directed acyclic graphs that enabled us to explicitly map the predictor-outcome relationship for well guided analysis and identification of possible confounders. Our study could not examine other factors such as poor attitude of nurses and lack of information on health care services offered which have been found by both quantitative and qualitative studies to hinder care utilization in low- and middle-income countries [85, 86]. Another limitation to our study was that inadequate facilities and drugs have also been associated with poor care-seeking, but our data did not capture these specific aspects [87]. In addition, the cross-sectional survey design of the DHS dataset does not allow collection of data on quality of care. Our study did not incorporate factors such as intimate partner violence (IPV) which prevalent in many countries, IPV is known to be associated with poor care-seeking behaviour [88]. Further studies can investigate this.

Conclusion

Further multi-country large-scale population-based research and systematic reviews could enable development and use of a brief standard questionnaire to determine a mother´s continued care-seeking level during the first ANC visit and use the information to close the care-seeking gaps where it´s most needed. This is especially viable in LMIC with limited health workforce. Similar standard questionnaires have been used previously in other areas to assess care-seeking behaviour [89, 90]. The use of mobile health (mHealth) specifically for promoting continued maternal care utilization up to postnatal can be integrated in the existing structures. Strengthening the existing community health workers system to be integral part of promoting continued maternal care-seeking could enhance care-seeking as a stand-alone strategy or as a component of the above suggested strategies.

Acknowledgments

Much appreciation to the DHS program and partners for availing the datasets for this study.

Competing interest statement

No competing interests were reported by the authors.

Ethics and dissemination

DHS data collection process and storage guaranteed the anonymity and confidentiality of participants. Datasets are publicly available and permission for access and use was obtained after sending a request to the DHS secretariat.

Funding

No funds were obtained from any entity or industry by the authors of this study.

Authors' contributions

MOA conceptualized, designed, obtained data for the study, conducted analysis, interpreted the results, drafted, and reviewed the manuscript. BOA and AA interpreted the results and conducted critical review of the manuscript. The final draft was agreed upon by all authors.

Data availability statement

DHS data used in this study are available for the public upon request. De-identified data was accessed from: https://dhsprogram.com/Data/.

References

1. United Nations Inter-Agency Child Mortality Estimation. Levels and trends in child mortality 2020 [Available from: https://www.unicef.org/media/79371/file/UN-IGME-child-mortality-report-2020.pdf . (accessed Jan 2021)
2. Neonatal Mortality. Neonatal period is the most vulnerable time for a child [Internet]. UNICEF. 2020 [cited January 2021]. Available from: https://data.unicef.org/topic/child-survival/neonatal-mortality/. (accessed Jan 2021)
3. World Health Organization. Newborn death and illness 2011 [Available from: https://www.who.int/pmnch/media/press_materials/fs/fs_newborndealth_illness/en/.
4. World Health Organization. Newborn death and illness 2005 [Available from: https://www.who.int/pmnch/media/press_materials/fs/fs_newborndealth_illness/en/. (accessed Jan 2021)
5. World Health Organization. Newborns: improving survival and well-being: key facts 2021 [Available from: https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality. (accessed Jan 2021)
6. World Health Organization. Positive experiences, key to antenatal care uptake and quality 2019 [Available from: https://www.who.int/reproductivehealth/antenatal-care-uptake/en/. (accessed Jan 2021)
7. World Health Organization. Newborns: improving survival and well-being 2020 [Available from: https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality. (accessed Jan 2021)
8. Swedish Public Health Agency (Folkhälsomyndigheten). Infant mortality (Spädbarnsdödlighet) 2019 [Available from: https://www.folkhalsomyndigheten.se/folkhalsorapportering-statistik/tolkad-rapportering/folkhalsans-utveckling/resultat/halsa/spadbarnsdodlighet/. (accessed Jan 2021)
9. UN IGME. Levels and trends in child mortality report 2019. Estimates developed by the UN Inter-agency Group for Child Mortality Estimation. 2019.
10. Tessema ZT, Yazachew L, Tesema GA, Teshale AB. Determinants of postnatal care utilization in sub-Saharan Africa: a meta and multilevel analysis of data from 36 sub-Saharan countries. Ital J Pediatr. 2020;46(1):175.
11. Tran TK, Nguyen CT, Nguyen HD, Eriksson B, Bondjers G, Gottvall K, et al. Urban - rural disparities in antenatal care utilization: a study of two cohorts of pregnant women in Vietnam. BMC Health Serv Res. 2011;11:120.
12. Doctor HV, Nkhana-Salimu S, Abdulsalam-Anibilowo M. Health facility delivery in sub-Saharan Africa: successes, challenges, and implications for the 2030 development agenda. BMC Public Health. 2018;18(1):765.
13. World Health Organization. Make every mother and child count. Geneva, Switzerland; 2005.
14. Kerber KJ, de Graft-Johnson JE, Bhutta ZA, Okong P, Starrs A, Lawn JE. Continuum of care for maternal, newborn, and child health: from slogan to service delivery. Lancet. 2007;370(9595):1358-69.
15. Benova L, Dennis ML, Lange IL, Campbell OMR, Waiswa P, Haemmerli M, et al. Two decades of antenatal and delivery care in Uganda: a cross-sectional study using Demographic and Health Surveys. BMC Health Serv Res. 2018;18(1):758.
16. Kichamu G AJ, Karimurio L. Maternal and Child Health: Demographic and health survey.

17. Moller AB, Petzold M, Chou D, Say L. Early antenatal care visit: a systematic analysis of regional and global levels and trends of coverage from 1990 to 2013. Lancet Glob Health. 2017;5(10):e977-e83.
18. Gilson L, McIntyre D. Removing user fees for primary care in Africa: the need for careful action. Bmj. 2005;331(7519):762-5.
19. Andersen R, Newman JF. Societal and individual determinants of medical care utilization in the United States. Milbank Mem Fund Q Health Soc. 1973;51(1):95-124.
20. Okedo-Alex IN, Akamike IC, Ezeanosike OB, Uneke CJ. Determinants of antenatal care utilisation in sub-Saharan Africa: a systematic review. BMJ Open. 2019;9(10):e031890.
21. Neupane B, Rijal S, G CS, Basnet TB. Andersen's model on determining the factors associated with antenatal care services in Nepal: an evidence-based analysis of Nepal demographic and health survey 2016. BMC Pregnancy Childbirth. 2020;20(1):308.
22. Jadoon B, Mahaini R, Gholbzouri K. Determinants of over and underuse of caesarean births in the Eastern Mediterranean Region: an updated review. East Mediterr Health J. 2019;25(11):837-46.
23. Gu H, You H, Yan Z, Yang N, Kou Y, Sun J, et al. Determinants of the utilization of postpartum family visits: Evidence from rural areas of Eastern China. PLoS One. 2018;13(3):e0194061.
24. Shitie A, Assefa N, Dhressa M, Dilnessa T. Completion and Factors Associated with Maternity Continuum of Care among Mothers Who Gave Birth in the Last One Year in Enemay District, Northwest Ethiopia. J Pregnancy. 2020;2020:7019676.
25. Oh J, Moon J, Choi JW, Kim K. Factors associated with the continuum of care for maternal, newborn and child health in The Gambia: a cross-sectional study using Demographic and Health Survey 2013. BMJ Open. 2020;10(11):e036516.
26. Mohan D, LeFevre AE, George A, Mpembeni R, Bazant E, Rusibamayila N, et al. Analysis of dropout across the continuum of maternal health care in Tanzania: findings from a cross-sectional household survey. Health Policy Plan. 2017;32(6):791-9.
27. Downe S, Finlayson K, Tunçalp Ö, Gülmezoglu AM. Provision and uptake of routine antenatal services: a qualitative evidence synthesis. Cochrane Database Syst Rev. 2019;6(6):Cd012392.
28. World Health Organization. Africa´s newborns–counting them and making them count. [Available from: https://www.who.int/pmnch/media/publications/aonsection_I.pdf. (accessed Jan 2021)
29. Masaba BB, Mmusi-Phetoe RM. Neonatal Survival in Sub-Sahara: A Review of Kenya and South Africa. J Multidiscip Healthc. 2020;13:709-16.
30. The World Bank. Open Data, indicators, neonatal (per 1000 live births)-Kenya, Uganda, Rwanda. 1994–2019. 2021 [February 2021]. Available from: https://data.worldbank.org/indicator/SH.DYN.NMRT?locations=KE-UG-RW. (accessed Jan 2021)
31. Kenya National Bureau of Statistics. 2019 Kenya Population and Housing Census.: Distribution of population by socio-economic characteristics. 2019.
32. Uganda Bureau of Statistics (UBOS). 2020 Statistics abstract. 2020.
33. Uganda National Web Portal. Agriculture 2021 [March 2021]. Available from: https://www.gou.go.ug/content/agriculture. (accessed Jan 2021)
34. The World Bank. Open data source: Agriculture and Rural Development 2021 [March 2021]. Available from: https://data.worldbank.org/topic/agriculture-and-rural-development?locations=KE-UG. (accessed Jan 2021)
35. Uganda Bureau of Statistics (UBOS). Population and Census 2020 [March 2020]. Available from: https://www.ubos.org/explore-statistics/20/.(accessed Jan 2021)

36. The World Bank. Open data source: Life expectancy at birth, females - Kenya, Uganda [March 2021]. Available from: https://data.worldbank.org/indicator/SP.DYN.LE00.FE.IN?locations=KE-UG. (accessed Jan 2021)
37. Leone T, Cetorelli V, Neal S, Matthews Z. Financial accessibility and user fee reforms for maternal healthcare in five sub-Saharan countries: a quasi-experimental analysis. BMJ Open. 2016;6(1):e009692.
38. Ministry of health. Situation analysis of newborn health in Uganda: current status and opportunities to improve care and survival. Kampala: Government of Uganda. Save the Children, UNICEF,WHO. 2008.
39. Masaba BB, Mmusi-Phetoe RM. Free Maternal Health Care Policy in Kenya; Level of Utilization and Barriers. International Journal of Africa Nursing Sciences. 2020;13:100234.
40. Odokonyero T MF, Adong A, et al. Universal health coverage in Uganda: The critical health infrastructure, healthcare coverage and equity. 2017.
41. Ministry of health. Linda Mama Programme positioning Kenya on the Pathway to UHC, Health PS.
42. Ross AB, DeStigter KK, Rielly M, Souza S, Morey GE, Nelson M, et al. A low-cost ultrasound program leads to increased antenatal clinic visits and attended deliveries at a health care clinic in rural Uganda. PLoS One. 2013;8(10):e78450.
43. Kenya National Commission on Human rights. Implementing free maternal health care in Kenya. 2013.
44. Croft TA, MJ. Allen, K. et al.,. Guide to DHS Statistics. Rockville Maryland, USA:_ICF. 2018.
45. ICF International. Demographic and Health Survey: Interviewer´s manual. 2019: Rockville, Maryland.
46. Asamoah BO, Agardh A, Cromley EK. Spatial analysis of skilled birth attendant utilization in Ghana. Glob J Health Sci. 2014;6(4):117-27.
47. Sandberg J, Odberg Pettersson K, Asp G, Kabakyenga J, Agardh A. Inadequate knowledge of neonatal danger signs among recently delivered women in southwestern rural Uganda: a community survey. PLoS One. 2014;9(5):e97253.
48. Fisseha G, Berhane Y, Worku A, Terefe W. Distance from health facility and mothers' perception of quality related to skilled delivery service utilization in northern Ethiopia. Int J Womens Health. 2017;9:749-56.
49. Mwilike B, Nalwadda G, Kagawa M, Malima K, Mselle L, Horiuchi S. Knowledge of danger signs during pregnancy and subsequent healthcare seeking actions among women in Urban Tanzania: a cross-sectional study. BMC Pregnancy Childbirth. 2018;18(1):4.
50. Asp G, Odberg Pettersson K, Sandberg J, Kabakyenga J, Agardh A. Associations between mass media exposure and birth preparedness among women in southwestern Uganda: a community-based survey. Glob Health Action. 2014;7:22904.
51. Ahinkorah BO, Budu E, Seidu AA, Agbaglo E, Adu C, Ameyaw EK, et al. Barriers to healthcare access and healthcare seeking for childhood illnesses among childbearing women in sub-Saharan Africa: A multilevel modelling of Demographic and Health Surveys. PLoS One. 2021;16(2):e0244395.
52. Adedokun ST, Yaya S. Factors influencing mothers' health care seeking behaviour for their children: evidence from 31 countries in sub-Saharan Africa. BMC Health Serv Res. 2020;20(1):842.
53. Chakraborty NM, Fry K, Behl R, Longfield K. Simplified Asset Indices to Measure Wealth and Equity in Health Programs: A Reliability and Validity Analysis Using Survey Data From 16 Countries. Glob Health Sci Pract. 2016;4(1):141-54.

54. Textor J ZBV, Gilthorpe M.K, et al. Robust causal inference using directed acyclic graphs: the R package 'dagitty'.
. International Journal of Epidemiology 2016;45(9):1887-94.
55. Vilanova CS, Hirakata VN, de Souza Buriol VC, Nunes M, Goldani MZ, da Silva CH. The relationship between the different low birth weight strata of newborns with infant mortality and the influence of the main health determinants in the extreme south of Brazil. Popul Health Metr. 2019;17(1):15.
56. Magee BD. Role of multiple births in very low birth weight and infant mortality. J Reprod Med. 2004;49(10):812-6.
57. Enos JY, Amoako RD, Doku IK. Utilization, Predictors and Gaps in the Continuum of Care for Maternal and Newborn Health in Ghana. Int J MCH AIDS. 2021;10(1):98-108.
58. Tekelab T, Chojenta C, Smith R, Loxton D. Factors affecting utilization of antenatal care in Ethiopia: A systematic review and meta-analysis. PLoS One. 2019;14(4):e0214848.
59. Nigusie A, Azale T, Yitayal M. Institutional delivery service utilization and associated factors in Ethiopia: a systematic review and META-analysis. BMC Pregnancy Childbirth. 2020;20(1):364.
60. Tolera H, Gebre-Egziabher T, Kloos H. Risk factors for women's non-utilization of decentralized primary health care facilities for postnatal care in rural western Ethiopia. Ther Adv Reprod Health. 2020;14:2633494120928340.
61. Acharya D, Khanal V, Singh JK, Adhikari M, Gautam S. Impact of mass media on the utilization of antenatal care services among women of rural community in Nepal. BMC Res Notes. 2015;8:345.
62. Sumankuuro J, Crockett J, Wang S. Sociocultural barriers to maternity services delivery: a qualitative meta-synthesis of the literature. Public Health. 2018;157:77-85.
63. Ganle JK, Obeng B, Segbefia AY, Mwinyuri V, Yeboah JY, Baatiema L. How intra-familial decision-making affects women's access to, and use of maternal healthcare services in Ghana: a qualitative study. BMC Pregnancy Childbirth. 2015;15:173.
64. Dahab R, Sakellariou D. Barriers to Accessing Maternal Care in Low Income Countries in Africa: A Systematic Review. Int J Environ Res Public Health. 2020;17(12).
65. Thapa DK, Niehof A. Women's autonomy and husbands' involvement in maternal health care in Nepal. Soc Sci Med. 2013;93:1-10.
66. Fekadu GA, Kassa GM, Berhe AK, Muche AA, Katiso NA. The effect of antenatal care on use of institutional delivery service and postnatal care in Ethiopia: a systematic review and meta-analysis. BMC Health Serv Res. 2018;18(1):577.
67. Atuhaire R, Atuhaire LK, Wamala R, Nansubuga E. Interrelationships between early antenatal care, health facility delivery and early postnatal care among women in Uganda: a structural equation analysis. Glob Health Action. 2020;13(1):1830463.
68. Tiruneh GT, Worku A, Berhane Y, Betemariam W, Demissie M. Determinants of postnatal care utilization in Ethiopia: a multilevel analysis. BMC Pregnancy Childbirth. 2020;20(1):549.
69. World Health Organization. WHO recommendations on postnatal care of the mother and newborn. Geneva, Switzerland: World health Organization; 2014.
70. Ministry of health. Essential Maternal and Newborn Clinical Care Guidelines For Uganda. 2016.
71. Services MoPHaSaMoM. National Guidelines for quality obstetrics and perinatal care
72. World Health Organization. WHO recommendatons on antenatal for a positive pregnancy experience. 2016.
73. Fund UNC. Village health teams, key structures in saving mothers and their babies from preventable deaths 2018 [Available from:

https://www.unicef.org/uganda/stories/village-health-teams-key-structures-saving-mothers-and-their-babies-preventable-deaths. (accessed Jan 2021)
74. Agarwal S, Abuya T, Kintu R, Mwanga D, Obadha M, Pandya S, et al. Understanding community health worker incentive preferences in Uganda using a discrete choice experiment. J Glob Health. 2021;11:07005.
75. Kenya Moh-. Kenya Standards and Guidelines for mHealth Systems. 2017.
76. Kamulegeya LH, Ssebwana J, Abigaba W, Bwanika JM, Musinguzi D, editors. Mobile Health in Uganda: A Case Study of the Medical Concierge Group2019.
77. Lang'at E, Mwanri L, Temmerman M. Effects of implementing free maternity service policy in Kenya: an interrupted time series analysis. BMC Health Serv Res. 2019;19(1):645.
78. Atuoye KN, Barnes E, Lee M, Zhang LZ. Maternal health services utilisation among primigravidas in Uganda: what did the MDGs deliver? Global Health. 2020;16(1):40.
79. Njuguna J, Kamau N, Muruka C. Impact of free delivery policy on utilization of maternal health services in county referral hospitals in Kenya. BMC Health Serv Res. 2017;17(1):429.
80. Abuya T DM, Amanda D et al. Impacts of removing user fees for maternal health services on universal health coverage in Kenya. 2018.
81. Tama E, Molyneux S, Waweru E, Tsofa B, Chuma J, Barasa E. Examining the Implementation of the Free Maternity Services Policy in Kenya: A Mixed Methods Process Evaluation. Int J Health Policy Manag. 2018;7(7):603-13.
82. Gitobu CM, Gichangi PB, Mwanda WO. The effect of Kenya's free maternal health care policy on the utilization of health facility delivery services and maternal and neonatal mortality in public health facilities. BMC Pregnancy Childbirth. 2018;18(1):77.
83. Ministry of Health Kenya. Linda Mama Programme positioning Kenya on the Pathway to UHC, Health PS, 2020.
84. World Health Organization. A rapid assessment of health seeking behaviour in relation to sexually transmitted disease. 1995.
85. Nachinab GT, Adjei CA, Ziba FA, Asamoah R, Attafuah PA. Exploring the Determinants of Antenatal Care Services Uptake: A Qualitative Study among Women in a Rural Community in Northern Ghana. J Pregnancy. 2019;2019:3532749.
86. Kyei-Nimakoh M, Carolan-Olah M, McCann TV. Access barriers to obstetric care at health facilities in sub-Saharan Africa-a systematic review. Syst Rev. 2017;6(1):110.
87. Xu K, Evans DB, Kadama P, Nabyonga J, Ogwal PO, Nabukhonzo P, et al. Understanding the impact of eliminating user fees: utilization and catastrophic health expenditures in Uganda. Soc Sci Med. 2006;62(4):866-76.
88. Musa A, Chojenta C, Geleto A, Loxton D. The associations between intimate partner violence and maternal health care service utilization: a systematic review and meta-analysis. BMC Womens Health. 2019;19(1):36.
89. Stack RJ, Mallen CD, Deighton C, Kiely P, Shaw KL, Booth A, et al. The development and initial validation of a questionnaire to measure help-seeking behaviour in patients with new onset rheumatoid arthritis. Health Expect. 2015;18(6):2340-55.
90. World Health Organization. Draft protocol. A rapid assessment of health seeking behaviour in relation to sexually transmitted disease. 1995.

Figures and supplementary files

Figure legends

Figure 1: Proportions of antenatal care visits by number of ANC contacts in Kenya and Uganda, using demographic and health survey 2014-2016 data.

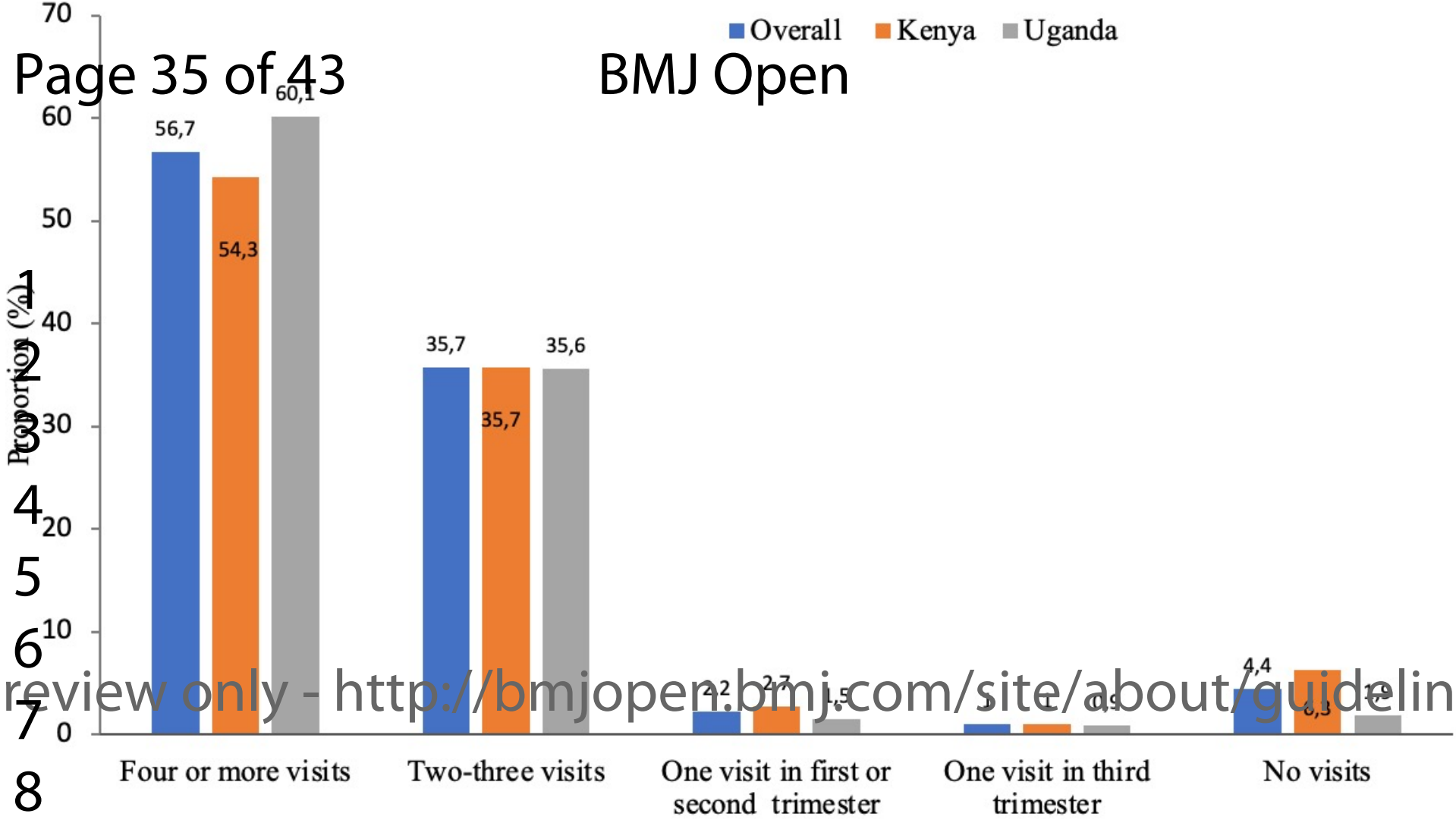
Figure 2. A scatter plot showing correlation between number of antenatal care visits and proportions of facility births and postnatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

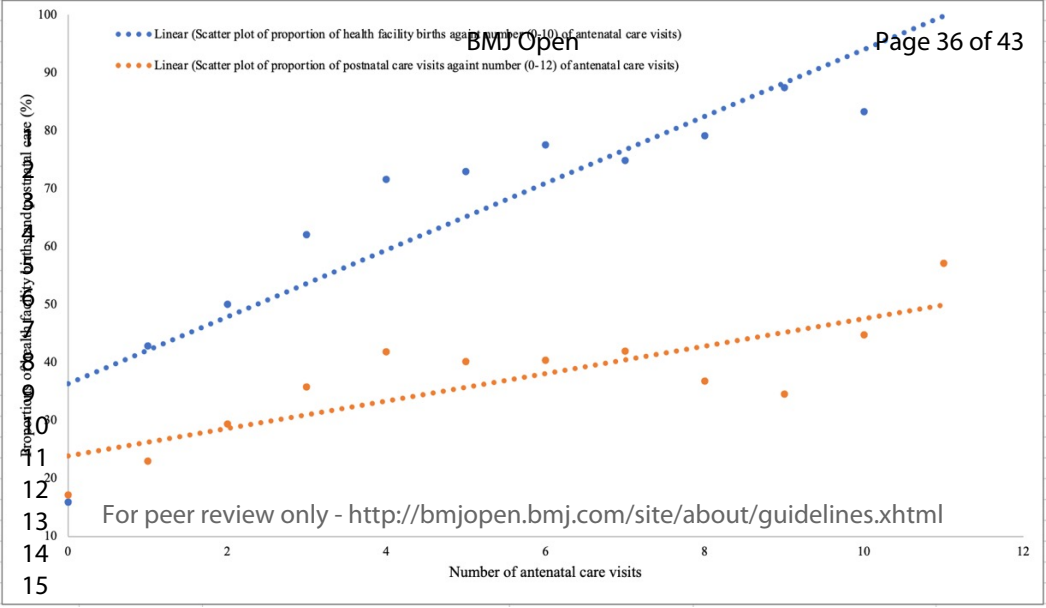
Figure 3. Proportion of hospital and home births by number of antenatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

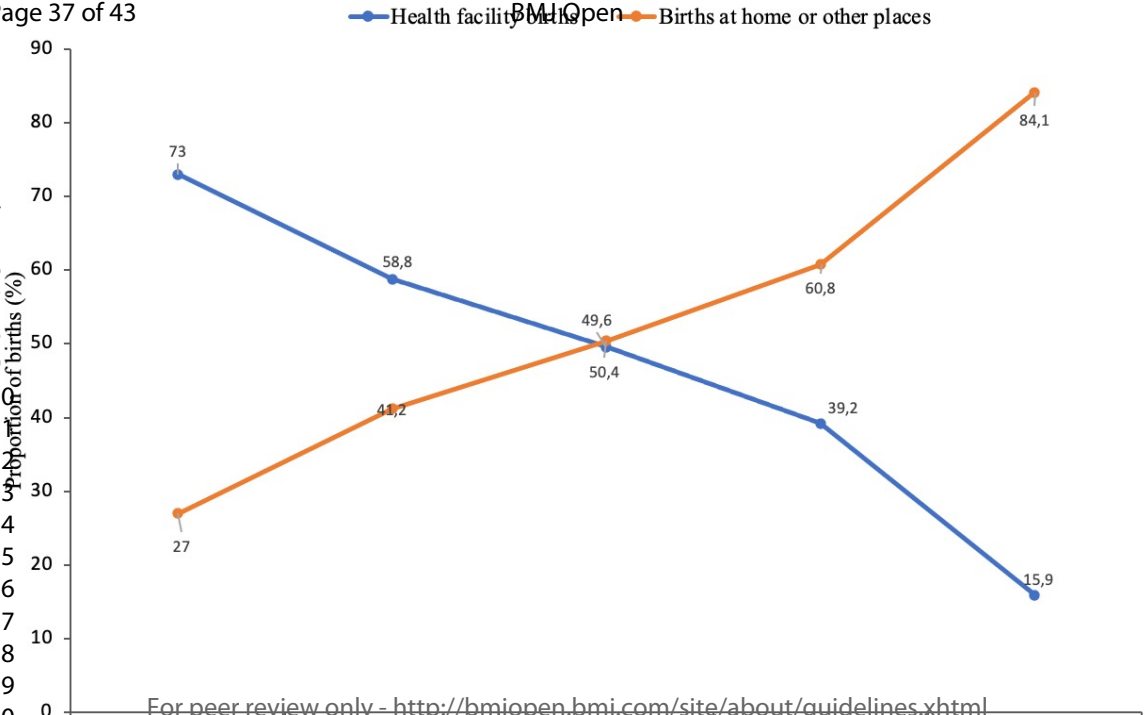
Figure 4: A forest plot showing relative risk ratios (RRR) for the associations between maternal and socio-demographic factors and maternal continuum of care-seeking behaviour in Kenya and Uganda, using demographic and health survey 2014-2016 data.

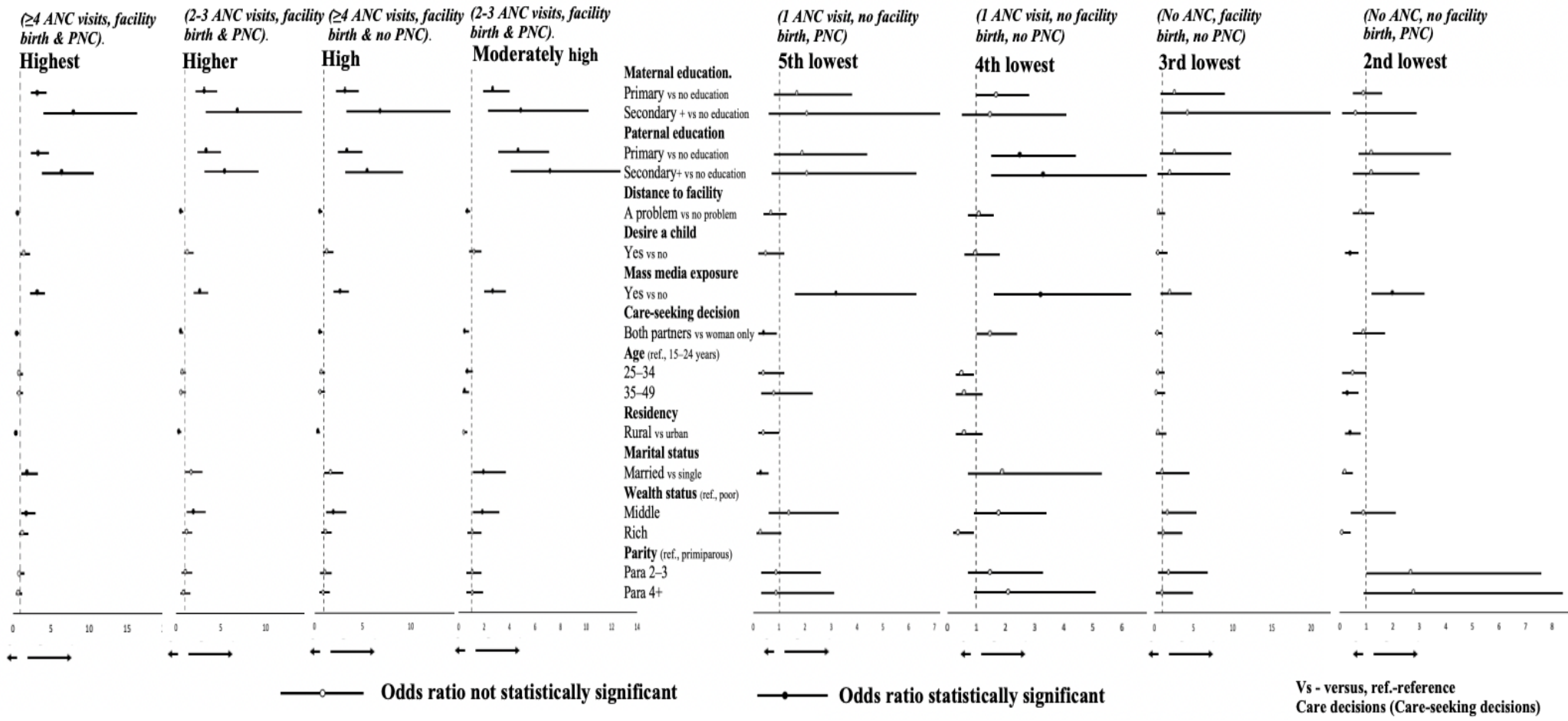
Figure 5: A forest plot showing adjusted odds ratios between continued care-seeking behavioral classes/levels and neonatal mortality, using Kenya and Uganda, 2014-2016 demographic and health survey data.

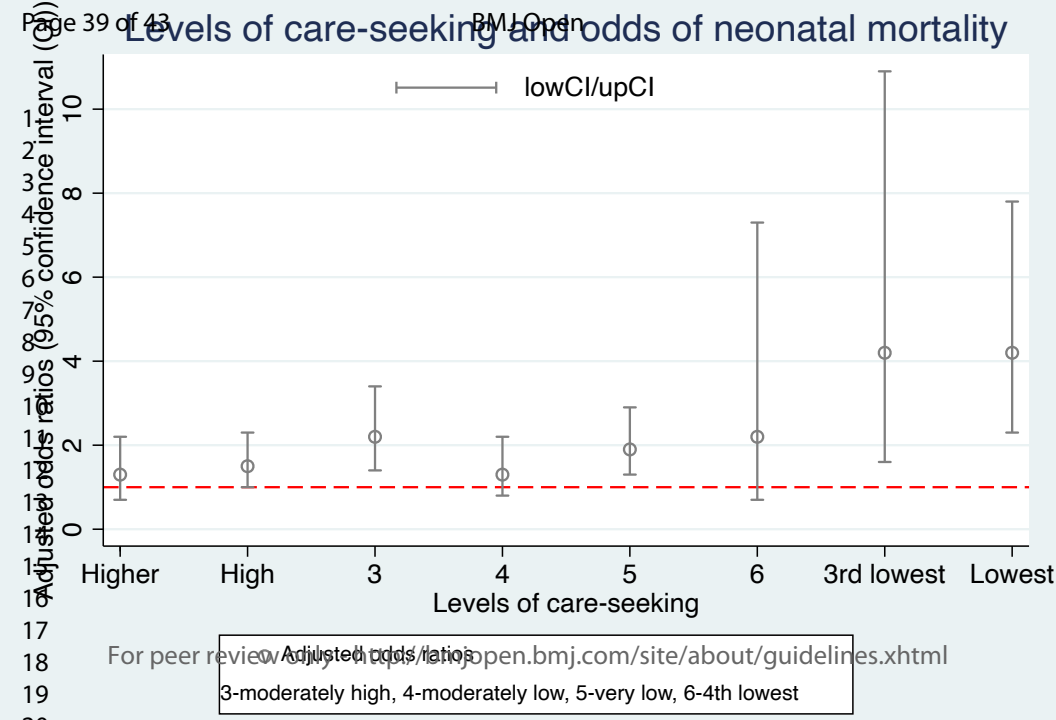
Figure 6: Attributable and population attributable neonatal mortality risk proportion for lower categories of care-seeking in Kenya and Uganda, using demographic and health survey 2014-2016 data.

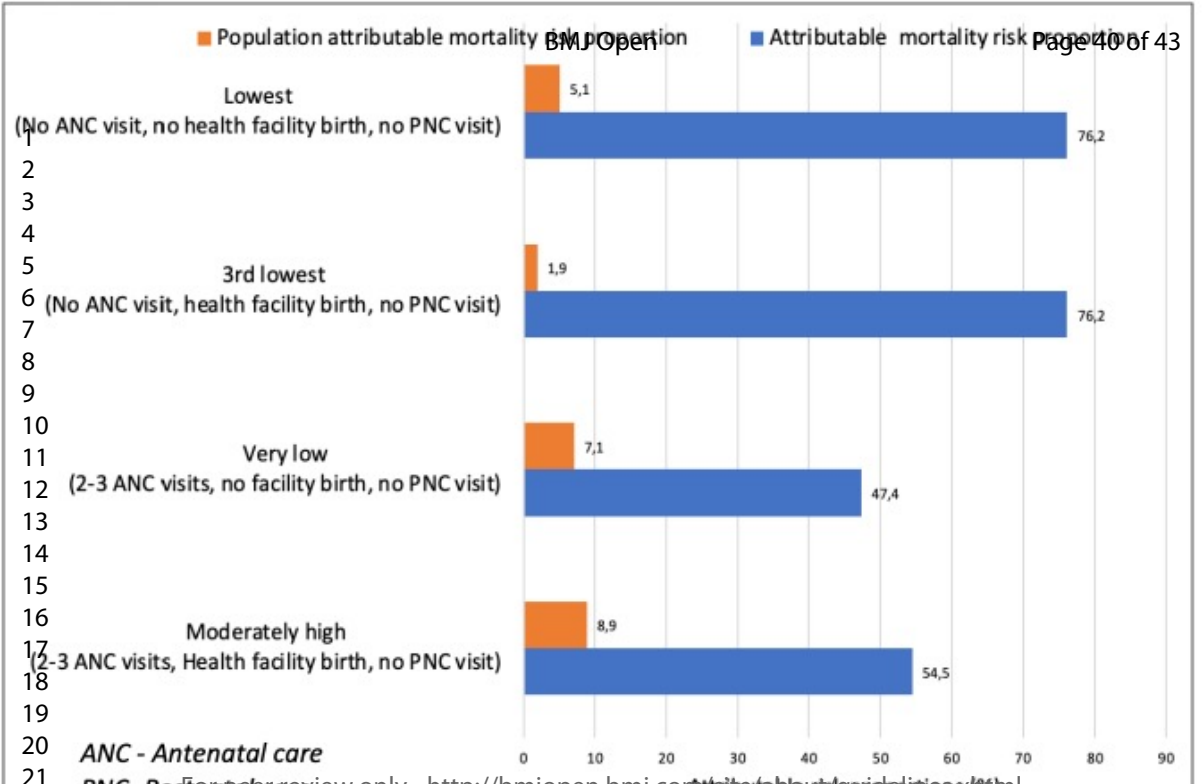







(≥4 ANC visits, facility birth & PNC).
Highest
(2-3 ANC visits, facility birth & PNC).
Higher
(≥4 ANC visits, facility birth & no PNC).
High
(2-3 ANC visits, facility birth & PNC).
Moderately high
(1 ANC visit, no facility birth, PNC)
5th lowest
(1 ANC visit, no facility birth, no PNC)
4th lowest
(No ANC, facility birth, no PNC)
3rd lowest
(No ANC, no facility birth, PNC)
2nd lowest
Maternal education.
Primary vs no education
Secondary + vs no education
Paternal education
Primary vs no education
Secondary+ vs no education
Distance to facility
A problem vs no problem
Desire a child
Yes vs no
Mass media exposure
Yes vs no
Care-seeking decision
Both partners vs woman only
Age (ref., 15–24 years)
25–34
35–49
Residency
Rural vs urban
Marital status
Married vs single
Wealth status (ref., poor)
Middle
Rich
Parity (ref., primiparous)
Para 2–3
Para 4+
Odds ratio not statistically significant
Odds ratio statistically significant
Vs - versus, ref.-reference
Care decisions (Care-seeking decisions)





ANC - Antenatal care

PNC -Postnatal care

Supplementary file 1.

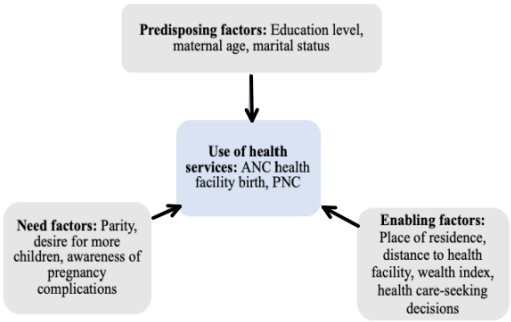


Figure showing behavioral model of utilization of health care services, modified from Andersen and Newman model.

Supplementary file 2.

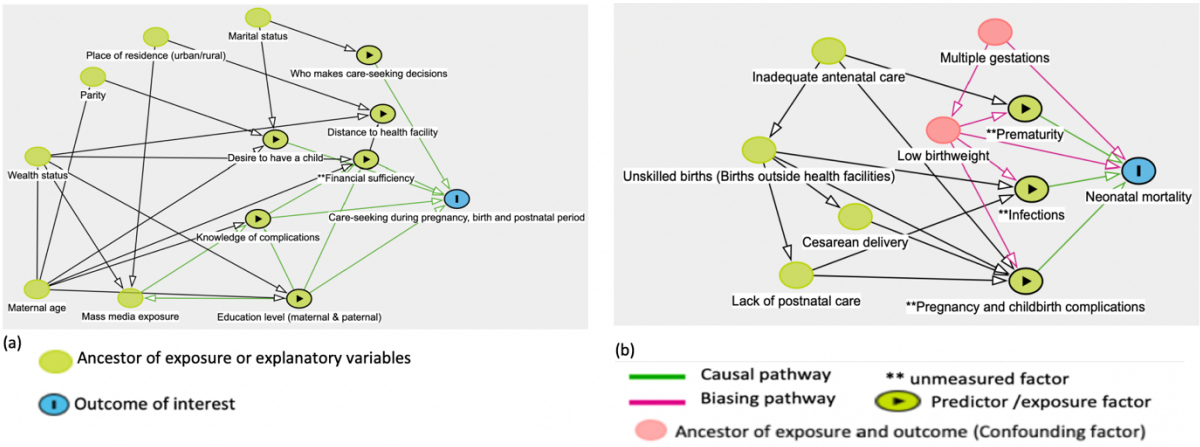


Figure 1: Directed acyclic graphs showing the predictor–outcome relationship for both care-seeking and neonatal survival in Kenya and Uganda, *(Developed from www.dagitty.net, using DAGitty version 3.0.)*

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Page 1, line 3. Page 2, line 5.
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found. Page 2, lines 1-28.
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 4, lines 1-34. And page 5 lines 1-27.
Objectives	3	State specific objectives, including any prespecified hypotheses. Page 5, Lines 24-27.
Methods		
Study design	4	Present key elements of study design early in the paper. Page 6, lines 14-22.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection. Page 5 line 31-34, Page 6 lines 1-22.
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Page 6, lines 15-22.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable. Page 6, lines 25-34. Page 7, lines 1-28. Page 8, lines 1-21
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Page 6, lines 15-22. Page 7, lines 1-28. Page 8, lines 1-20.
Bias	9	Describe any efforts to address potential sources of bias. Page 8, lines 15-30. Page 9, lines 1-16.
Study size	10	Explain how the study size was arrived at. N/A. Described for primary data collector, Page 6, 15-22
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why. Page 6, lines 26-34, Page 7, lines 1-28. Page 8, lines 1-21. Page 8. Page 9, 1-16.
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding. Page 8, lines 24-34. Page 9, lines 1-2.
		(*b*) Describe any methods used to examine subgroups and interactions. Page 8, lines 24-34. Page 9, lines 4-5.
		(*c*) Explain how missing data were addressed, Page 9, lines 11-15
		(*d*) If applicable, describe analytical methods taking account of sampling strategy. Page 9, 11-12.
		(*e*) Describe any sensitivity analyses, Subgroup analysis- Page 9, line 3-5.
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Page 10, table 2, lines 5-18, Pages 11, 12, 13, 14 table 4. Page 20 table 5
		(b) Give reasons for non-participation at each stage. Page 9, line 10-16. Page 20 table 5
		(c) Consider use of a flow diagram-N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and

		information on exposures and potential confounders. Page 9-14, table 2 and table 4
		(b) Indicate number of participants with missing data for each variable of interest. Page 20, table 5, Page 9, lines 10-15.
Outcome data	15*	Report numbers of outcome events or summary measures. Page 6, lines 26-34. Page 7, lines 1-18. Page 20 table 5.
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included. Page 17-19, table 4. Page 20, table 5. Page 20, lines 1-14. Page 21, lines 4-5.
		(*b*) Report category boundaries when continuous variables were categorized. N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period. Attributable risk fraction (difference between absolute risks in two groups) Page 9, lines 20-24 and Figure 6.
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses. Page 9, lines 4-5. Subgroup analysis- Page 20 table 5
Discussion		
Key results	18	Summarise key results with reference to study objectives. Page 21, lines 19-33. Page 22, lines 1-19. Page 23, lines 1-22.
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. Page 25, lines 1-21.
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. Discussion section, pages 21-25
Generalisability	21	Discuss the generalisability (external validity) of the study results. Page 26, lines 4-5
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based. Page 27, line 14

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Determinants of continued maternal care-seeking during pregnancy, birth and postnatal and associated neonatal survival outcomes in Kenya and Uganda: analysis of cross-sectional, demographic and health survey data.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-054136.R2
Article Type:	Original research
Date Submitted by the Author:	16-Oct-2021
Complete List of Authors:	Arunda , Malachi; Lund University, Social Medicine and Global Health, Department of Clinical Sciences, Malmö. Agardh, Anette; Lund University, Social Medicine and Global Health, Department of Clinical Sciences, Malmö Malmö, SE Asamoah, Benedict ; Lund University, Social Medicine and Global Health, Department of Clinical Sciences, Malmö
Primary Subject Heading:	Global health
Secondary Subject Heading:	Reproductive medicine
Keywords:	EPIDEMIOLOGY, PUBLIC HEALTH, Community child health < PAEDIATRICS

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Determinants of continued maternal care-seeking during pregnancy, birth and postnatal and associated neonatal survival outcomes in Kenya and Uganda: analysis of cross-sectional, demographic and health survey data.

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Abstract

Objectives: To examine how maternal and sociodemographic factors determine continued care-seeking behaviour from pregnancy to postnatal period in Kenya and Uganda and to determine associated neonatal survival outcomes.

Design: A population-based analysis of cross-sectional data using multinomial and binary logistic regressions.

Setting: Countrywide, Kenya, and Uganda.

Participants: Most recent live births of 24,502 mothers within 1-59 months prior to the 2014-2016 demographic and health surveys.

Outcomes: Care-seeking continuum and neonatal mortality.

Results: Overall, 57% of the mothers had 4 or more antenatal care contacts, of which 73% and 41% had facility births and postnatal care, respectively. Maternal/paternal education versus no education were associated with continued care-seeking in majority of care-seeking classes; relative risk ratios, RRR ranged from 2.1–8.0 (95% confidence intervals [95% CI] 1.1–16.3). Similarly, exposure to mass media was generally associated with continued care-seeking, RRRs ranged from 1.8– 3.2 (95% CI 1.2–5.4). Care-seeking tendency reduced if a husband made major maternal care-seeking decisions. Transportation problems and living in rural versus urban were largely associated with lower continued care utilization, RRR ranged from 0.4 – 0.7 (95% CI 0.3–0.9). The two *lowest* care-seeking categories with no ANC and no PNC indicated the highest odds for neonatal mortality, aOR 4.2 (95% CI_{range} 1.6-10.9). 23% neonatal deaths were attributable to inadequate maternal care attendance.

Conclusion: Strategies such as mobile health specifically for promoting continued maternal care utilization up to postnatal could be integrated in the existing structures. Another strategy would be to develop and employ a brief standard questionnaire to determine a mother´s continued care-seeking level during the first ANC visit and use the information to close the care-seeking gaps. Strengthening the community health workers system to be integral part of promoting continued care-seeking could enhance care-seeking as a stand-alone strategy or as a component of suggested strategies above.

Keywords: Continued care-seeking behaviour, neonatal mortality.

Strengths and limitations of this study

- The nationally representativeness of the data and the large sample size of the study allowed for valid stratified analysis with implications for national policy developments to improve neonatal survival outcomes for countries in sub-Saharan Africa region.

- Recall bias may not be completely eliminated from the study since the data was collected retrospectively through interviews.

- However, by selecting the most recent births and owing to the fact that childbirth is a special event not easily forgettable, the study findings reflect the reality with considerable validity.

- The study was based on maternal attendance to care and not the actual obstetric services received thus aspects related to lack of drugs, inadequate facilities or quality of care were not captured in our study.

Introduction

In 2019, close to 7000 newborns worldwide died within their first 28 days of life (neonatal period), as per the United Nations Inter-Agency Group for Child Mortality Estimation [1]. Roughly three-quarters of these deaths occurred during childbirth and the first week of neonatal period [1, 2] and the major causes included infections such as sepsis and pneumonia, birth complications and prematurity-related problems such as asphyxia and low birthweight [3]. Comprehensive antenatal care (ANC), skilled birth attendance and postnatal (afterbirth) care (PNC) have long been recognized as key strategies that profoundly contribute to newborn survival [4, 5]. In 2015, 64% of women globally had 4 or more ANC contacts [6] and prevalence of health facility births was 80% in 2019 [7]. In high income countries such as in Sweden where neonatal death rate is among the lowest globally (1.4 deaths per 1000 live births, in 2019), almost all mothers obtain comprehensive ANC, facility births and PNC services [8]. However, in sub-Sahara African (SSA) and southeast Asian countries where over 70 percent of all neonatal deaths occur [9], utilization of the components of care is relatively low and vary substantially [10-12].

Accordingly, since 2005, the World Health Organization (WHO) has been advocating for the implementation of continuum of care strategy [13], a concept that promotes continual access to care from pre-pregnancy to the first few weeks of after childbirth [13,14]. While several SSA countries including Kenya and Uganda report over 80% coverage of at-least-one ANC contact with skilled provider [15,16], late initiation of ANC visits, lower health facility births and very low PNC utilization still pose enormous challenges. A Lancet study reported that prevalence of early initiation of ANC contact (<14 weeks gestation) was only 24% in SSA, much lower compared to 85% in high income countries [17]. The challenge in a number of SSA countries, however, is that despite the removal of user fees for all maternal and child health service in many countries, a number of sociodemographic factors and maternal characteristics still remain critical determinants of care utilization that hinder or motivate choices and preferences in maternal care-seeking [18].

Andersen and Newman behavioral model of utilization of health care services has widely been used to identify factors that influence care-seeking behavior [19]. The model outlines three main factors that interact to predict utilization of care and they included societal, individual and health system determinants [19]. See diagrammatic details in Supplementary file 1. The model has been employed by studies to examine utilization of the different

components of maternal and newborn care such as ANC [20, 21], childbirth [22] or PNC [23]. However, very few studies in SSA have assessed how factors in the Andersen and Newman model modify care-seeking behavior along the continuum of care from pregnancy to postnatal period, and even much fewer within the context of free maternity policy.

A recent community-based study in Ethiopia showed that women with higher education, married women, and those with autonomy in health care decision were likely to complete continuum of care [24]. Whereas the study provided critical findings, it considered only 1 ANC visit and not the WHO or Ministry of Health (MoH) recommended number of contacts [24]. Another similar study by Oh et al. in 2013 in Gambia also found a number of factors associated with maternal care-seeking continuum and early ANC visits [25]. However, the study lacked PNC estimates for facilities deliveries [25]. Another sub-nationally study in Tanzania found, among other factors, knowledge or experience of pregnancy danger signs was associated with higher care-seeking [26]. A 2019 Cochrane review of several qualitative studies found that influence by others, illness-free pregnancy, financial dependence, and selective use of ANC as potential barriers to continual maternal care utilization [27]. The few existing studies on continuum of care-seeking in SSA are very informative but limited in one way or another, and none to our knowledge examined associated neonatal survival outcomes.

Kenya and Uganda are among the 10 countries in SSA countries with most neonatal deaths [28] and despite relatively free or subsidized maternity policy in both countries and relatively higher gross domestic product (GDP) than some countries in the East Africa region such as Rwanda, neonatal mortality rates have declined much slower compared to Rwanda [29, 30]. Thus, this study aims to examine how sociodemographic and maternal factors influence care-seeking behaviour in the care-seeking continuum from pregnancy, childbirth to postnatal period in Kenya and Uganda. A secondary aim was to estimate the impact of levels of continued maternal care-seeking on neonatal survival.

Methods

Study settings

Kenya and Uganda have closely comparable demographics and are in relatively similar state of maternal health care policy and pathway towards achieving universal coverage. The total population in Kenya and Uganda as of 2016-2019 was about 90 million [31, 32]. More than 70 % of the populations live in the rural areas with agriculture as their main source of

livelihood [31, 33, 34]. The sex ratio is approximately 1:1 [31, 35] and general life expectancy at birth in 2016 was similar in both countries, for females it was 64 and 67 years in Uganda and Kenya, respectively [36]. Maternal mean age at first childbirth is 19–20 years. Neonatal mortality rates in both countries were about 22 deaths per 1000 live births in 2016 [30]. Like a number of countries in SSA, Kenya and Uganda provide free maternal care services in primary level health facilities [37]. Although the goal of the free maternity programmes in Kenya and Uganda is to eliminate all maternity-related costs, however, due to inadequate or slow distribution of funding in some health facilities, certain hidden costs such as for ultrasound, access to hospital card and laboratory services among others are still incurred out-of-pocket [38-42]. Additionally, indirect expenses such as costs of transportation to the health facility are still challenges common among poor households [39]. Further, in Kenya, prior to June 2013 maternal services were partly free and partly subsidized [43].

Data source and study design

We obtained the cross-sectional, population-representative, demographic and health survey (DHS) datasets for Kenya 2014 and Uganda 2016 after a formal request to the DHS secretariat. DHS collects sociodemographic, maternal and child health data across the whole country in a two-stage cluster sampling procedure. The DHS uses standard procedures and protocols that ensure complete anonymity of the respondents and adherence to international ethical standards for research. We utilized the data for the most recent live births, 1-59 months prior to the surveys. More details on data collection procedure can be accessed from DHS methodology and manuals [44, 45].

Study variables

Outcome variables

Care-seeking continuum was the primary outcome variable. It constituted a combination of the number of ANC visits, health facility birth and at least one PNC contact within 28 days postpartum (after birth). Continuum of care-seeking was categorized into 15 classes based on relative adherence to basic (modified) WHO and MoH recommendations for care attendance from pregnancy to postnatal period prior to 2016, that is, before the current WHO recommendation of 8 ANC visits. Since data for both countries were collected prior to the new WHO 2016 ANC recommendations, we used previous Focused ANC recommendations. A mother with a combination of 4 or more visits, health facility birth (skilled birth) and at least 1 PNC contact was classified in the *highest* category of care-seeking and those with

least/no amount of care were categorized as *lowest* class. The intermediate categories were classified on the basis of optimal and perceived descending-level of care-seeking behavior as *higher*, *high, moderately high, slightly high, moderately low, moderately lower, very low, 7th lowest, 6th lowest, 5th lowest, 4th lowest, 3rd lowest, 2nd lowest and lowest,* as shown in Table 1 below.

Table 1: Classification of continuum of care-seeking classes during antenatal period, childbirth and within 28 days postnatal period in Kenya and Uganda.

	≥ 4 ANC visits	2-3 ANC visits	1 ANC visit	0 ANC visit
Health facility births				
PNC - Yes	Highest	Higher	7th lowest	–
PNC - No	High	Moderate high	6th lowest	3rd lowest
Birth outside of health facility				
PNC - Yes	Slightly high	Moderately lower	5th lowest	2nd lowest
PNC - No	Moderately low	Very low	4th lowest	Lowest

ANC – Antenatal care, PNC – Postnatal care, 1st – first, 2nd – Second…

The first component of classification was in accordance with the number of ANC visits a mother had, the second level was on the basis of whether or not a mother delivered at the health facility and the last part of continuum of care was whether or not a mother had PNC visit within 28 days postpartum.

Neonatal mortality was a secondary outcome variable that was dichotomized into *`yes´* (died) and *`no´* (lived) depending on whether the neonate lived or not. The predictor variables for this outcome variable were the modified classes of care-seeking continuum discussed as the primary outcomes above.

Independent variables

These constituted sociodemographic factors and maternal characteristics that were examined across all care-seeking continuum categories of the primary outcome variable. They included variables that the modified Andersen and Newman behavioral model for care utilization identified as predictors of care-seeking behavior [19]. Further, the categorization of these variables was also informed by a number of maternal and child health studies previously conducted in SSA. They included *maternal age* which was initially grouped as 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49 years old and we recategorized it into 15–24, 25–34 and

35–49 years years old while *place of residence* remained as *rural* and *urban* [46]. *Marital status* was dichotomized into single or married [47]. A mother having a *problem with longer distance/transportation to nearest health facility* was classified as `yes´ if it was a problem and `no´ if it was not [48]. *Desire to have a newborn child, whether or not mother was told about pregnancy complications* [49] *and having exposure to mass media* [50] *were all categorized as ´yes´ and ´no´*. The variable *who ultimately makes maternal care-seeking decisions* was categorized as respondent (woman) alone, husband alone or joint decision [51]. *Education* was categorized as no education, primary education and secondary or higher [52]. *Parity* (number of children ever born) was categorized as primiparous (for first time mothers) para 2-3 (for those with 2-3 children) and para 4+ [46]. *Wealth status* was classified into poor (poor/poorest), middle and rich(rich/richest) [52, 53]. The wealth status in DHS is indexed based on household cumulative living standards taking into account assets possessed, water and sanitation facilities. Place of residence was classified into rural and urban [53].

Mapping the predictor – outcome relationship using directed acyclic graphs

Prior to the analysis, the directed acyclic graphs (DAGs) by Textor and colleagues [54] were used to map the predictors of both care-seeking behaviors and neonatal mortality on the basis of existing peer-reviewed evidence and to identify any confounding bias in our models. Supplementary file 2, Diagrams 1.a and b illustrate the process. For Diagram 1.b, the lower levels of care-seeking are represented by a lack of a care component(s) that is/are major non-causal risk factor for neonatal mortality.

Data analysis

We used cross-tabulations to examine the distribution of mothers across variables and variable categories in the different levels of care-seeking continuum. We also investigated correlations between ANC visits and proportions of health facility childbirths and PNC visits. Multinomial logistic regression models examined the associations between sociodemographic and maternal factors and continued care-seeking at different care-seeking classes/categories, with the *lowest* class as the reference group. The independent variables were mutually adjusted for each other.

Binary logistic regression was used to determine the odds ratios (OR) for the associations between the various classes of care-seeking continuum and neonatal mortality. For plausible and valid analysis, 9 classes with satisfactory data were used in the overall mortality analysis

with the *highest* class as the reference group. Low birthweight babies and multiple gestations are strong independent risk factors for neonatal death, [55, 56], thus were excluded in the mortality analysis to obtain adjusted OR. The rest of the classes were not used owing to fewer numbers in certain neonatal mortality strata. Similarly, country-specific analysis resulted into elimination of more strata with fewer numbers. Further, the resulting significant adjusted odds ratios were used to estimate attributable risk fraction (AR) and population attributable risk fraction (PAR) for both countries combined. This was to determine proportion of neonatal deaths that would be prevented if mothers in a given lower level of care-seeking continuum had sought care at the *highest* class. We used Stata version 16 (College Station, TX: Stata Press) and Microsoft Excel for analysis and to generate graphical summaries of results. Sampling weights were applied, and we accounted for complex sampling design recommended by the DHS methodology guide. Missing data due to nonresponse were mostly negligible compared to the sub-population samples sizes and relatively randomly spread across the variable subgroups; they were nevertheless omitted in our analysis. For the variable "Knowledge about pregnancy, birth complications" where data was missing for Uganda, the analysis was only performed for Kenya where plausible.

Estimating attributable neonatal mortality risk proportions associated with low levels of care-seeking continuum.

The attributable risk proportions (AR) and population attributable neonatal mortality risk proportion (PAR) were obtain by the formulas AR = $[(OR{-}1)/OR)] * 100$ and PAR = Pe * $[(OR{-}1)/OR)] * 100$ respectively, where OR is the statistically significant adjusted odds ratio associated with that care-seeking class and *Pe* is the proportion of the total mortalities in that given care-seeking class.

Public and Patient Involvement

No patients or public were directly involved in this study.

Results

Table 2 and Figure 1 indicate that over 95% of mothers had at least 1 ANC visit and about 56% had 4 or more ANC contacts in Kenya and Uganda. Of those who had 4 or more ANC visits, 73% gave birth at a health facility and about 41% had newborn PNC check-up within 28 days after birth as shown in Table 2.

Table 2: Distribution of mothers by continuum of care-seeking classes during antenatal period, childbirth and within 28 days postnatal in Kenya and Uganda, using demographic and health survey 2014-2016 data, N=24502.

	≥ 4 ANC visits, n=13888	2-3 ANC visits, n=8744	1 ANC visit, N=775	0 ANC visit, N=1095
Health facility births				
PNC - Yes	4961(35.7)	2355(26.9)	115	68(6.2)
PNC - No	5179(37.3)	2782(31.8)	213	106(9.6)
Birth outside of health facility				
PNC - Yes	752(5.4)	632(7.2)	63	121(11.1)
PNC - No	2996(21.6)	2975(34.0)	384	800(73.1)

ANC – Antenatal care, PNC – Postnatal care,

The scatter plot in Figure 2 shows a positive correlation between number of antenatal care visits and both proportions of facility births and PNC visits. Further, Figure 3 shows that a single early ANC visit in the 1st or 2nd trimester increased the likelihood of health facility childbirth as opposed to late ANC visit in the 3rd trimester.

Table 3 shows the distribution of maternal and sociodemographic characteristics by care-seeking behaviour from pregnancy to postnatal period. Majority (≥ 46%) of the mothers were between 25–34 years of age in all care-seeking categories. Overall, about 71% of the mothers lived in a rural setting and 37 % of all women had problems with distance to the nearest health facility. Roughly 30 % and 57% of those who had highest and lowest care-seeking tendencies respectively, indicated distance could be a hindrance to care-seeking. Slightly over half of all the mothers had primary education. About 40% of highest care-seekers had secondary or higher education while 60% of lowest care-seekers had no formal education. Similar trends were observed among their husbands/partners (education).

1
2
3

Table 3. Distribution of maternal and sociodemographic factors, by continuum of care-seeking classes combining antenatal care (ANC) visits, delivery and postnatal care (PNC) in Kenya and Uganda, using demographic and health survey 2014-2016 data.

	4 or more ANC visits, n=13888				2-3 ANC visits, n=8744				1 ANC visits, n=775				0 ANC visit, n=1027		
Variables	**Highest** *(facility birth & PNC).* *n* (%)	**High** (facility *birth, no PNC).* *n* (%)	**Slightly high** (*no facility birth, PNC).* *n* (%)	**Mod-low** *(no facility birth, no PNC).* n (%)	**Higher** *(facility birth, PNC).* *n (%)*	**Mod-high** *(facility birth, no PNC).* *n* (%)	**Mod-lower** *(no facility birth, PNC).* *n* (%)	**Very low** *(no facility birth, no PNC).* *n* (%)	**7th lowest** *(facility birth, PNC)* *n* (%)	**6th lowest** *(facility birth, no PNC)* *n* (%)	**5th lowest** *(no facility birth, PNC)* *n* (%)	**4th lowest** *(no facility birth, no PNC)* *n* (%)	**3rd lowest** *(facility birth, no PNC)* *n* (%)	**2nd lowest** *(no facility birth, PNC)* *n* (%)	**Lowest** *(no facility birth, no PNC)* *n* (%)
Maternal age (Years)															
15-24	1625 (32.8)	1680 (32.4)	213 (28.3)	815 (27.2)	832 (35.3)	1001 (36.0)	159 (25.2)	778 (26.2)	51 (44.4)	77 (36.2)	20 (31.8)	123 (32.0)	43 (40.6)	36 (29.7)	189 (23.6)
25-34	2406 (48.5)	2513 (48.5)	315 (46.6)	1410 (47.1)	1064 (45.2)	1240 (44.6)	303 (47.9)	1385 (46.6)	35 (30.4)	91 (42.7)	17 (27.0)	160 (41.7)	41 (38.7)	52 (43.0)	360 (45.0)
35-49	930 (18.7)	986 (19.1)	189 (25.1)	771 (25.7)	459 (19.5)	541 (19.4)	170 (26.9)	812 (27.3)	29 (25.2)	45 (21.1)	26 (41.2)	101 (26.3)	22 (20.7)	33 (27.3)	251 (31.4)
Place of residence															
Urban	1669 (33.6)	2096 (40.5)	164 (21.8)	483 (16.1)	677 (28.8)	956 (34.4)	122 (19.3)	409 (13.8)	30 (26.1)	79 (37.1)	14 (22.2)	52 (13.5)	33 (31.1)	18 (14.9)	85 (10.6)
Rural	3292 (66.4)	3083 (59.5)	588 (78.2)	2513 (83.9)	1678 (71.3)	1826 (65.6)	510 (80.7)	2566 (86.2)	85 (73.9)	134 (62.9)	49 (77.8)	332 (86.5)	73 (68.9)	103 (85.1)	715 (89.4)
Distance to nearest health facility is a big problem															
No	3490 (70.3)	1561 (66.5)	472 (62.8)	876 (52.3)	1580 (67.1)	810 (62.9)	379 (60.1)	862 (50.5)	74 (64.4)	60 (63.2)	36 (57.1)	97 (47.1)	34 (68)	62 (51.2)	148 (42.8)
Yes	1471 (29.7)	785 (33.5)	280 (37.2)	798 (47.7)	775 (32.9)	477 (37.1)	252 (39.9)	844 (49.5)	41 (35.6)	35 (36.8)	27 (42.9)	109 (52.9)	16 (32.0)	59 (48.8)	198 (57.2)
Maternal education level															
No education	435 (8.8)	389 (7.5)	167 (22.2)	811 (27.1)	241 (10.2)	271 (9.8)	140 (22.2)	726 (24.4)	15 (13.0)	42 (19.7)	18 (28.6)	139 (36.2)	20 (18.9)	63 (52.0)	486 (60.8)
Primary	2535 (51.1)	2721 (52.5)	486 (64.6)	1789 (59.7)	1369 (58.2)	1645 (59.1)	399 (63.1)	1960 (65.9)	73 (63.5)	124 (58.2)	37 (58.7)	218 (56.8)	57 (53.8)	52 (43.0)	280 (35.0)

Mod- Moderately.

Variables	4 or more ANC visits, n=13888				2-3 ANC visits, n=8744				1 ANC visits, n=775				0 ANC visit, n=1027		
	Highest *(facility birth & PNC). n* (%)	**High** (facility *birth, no PNC). n* (%)	**Slightly high** (*no facility birth, PNC). n* (%)	**Mod-low** *(no facility birth, no PNC).* n (%)	**Higher** *(facility birth, PNC). n (%)*	**Mod-high** *(facility birth, no PNC). n* (%)	**Mod-lower** *(no facility birth, PNC). n* (%)	**Very low** *(no facility birth, no PNC). n* (%)	**7th lowest** *(facility birth, PNC) n* (%)	**6th lowest** *(facility birth, no PNC) n* (%)	**5th lowest** *(no facility birth, PNC) n* (%)	**4th lowest** *(no facility birth, no PNC) n* (%)	**3rd lowest** *(facility birth, no PNC) n* (%)	**2nd lowest** *(no facility birth, PNC) n* (%)	**Lowest** *(no facility birth, no PNC) n* (%)
Secondary and higher	1991 (40.1)	2069 (40.0)	99 (13.2)	396 (13.2)	745 (31.6)	866 (31.1)	93 (14.7)	289 (9.7)	27 (23.5)	47 (22.1)	8 (12.7)	27 (7.0)	29 (27.3)	6 (5.0)	34 (4.3)
Partner/husband education level															
No education	255 (6.1)	128 (6.5)	118 (16.9)	276 (19.1)	142 (7.4)	68 (6.5)	98 (16.8)	259 (17.5)	7 (8.4)	17 (23.0)	13 (23.2)	39 (23.8)	4 (13.8)	52 (49.5)	173 (55.0)
Primary	1860 (44.6)	991 (50.3)	401 (57.5)	815 (56.5)	1011 (52.4)	590 (56.2)	348 (59.8)	938 (63.5)	46 (55.4)	39 (52.7)	32 (57.1)	96 (58.5)	19 (65.5)	43 (41.0)	109 (35.3)
Secondary & higher	2059 (49.3)	851 (43.2)	179 (25.6)	352 (24.4)	777 (40.2)	392 (37.3)	136 (23.4)	280 (19.0)	30 (36.1)	18 (24.3)	11 (19.6)	29 (17.7)	6 (20.7)	10 (9.5)	27 (8.7)
Knowledge about pregnancy, birth complications (only Kenya)															
No	537 (32.8)	319 (39.1)	348 (47.4)	286 (63.4)	341 (45.6)	250 (53.7)	349 (55.6)	351 (66.9)	29 (64.4)	23 (50.0)	44 (69.8)	63 (75.9)	–	–	–
Yes	1099 (67.2)	496 (60.9)	386 (52.6)	165 (36.6)	407 (54.4)	216 (46.3)	279 (44.4)	174 (33.1)	16 (35.6)	23 (50.0)	19 (30.2)	20 (24.1)	–	–	–
Desire to have a child,															
No	142 (8.7)	215 (9.2)	97 (12.9)	206 (12.3)	249 (10.6)	153 (11.9)	120 (19.0)	257 (15.1)	24 (20.9)	22 (23.2)	18 (28.6)	40 (19.4)	7 (14.0)	29 (24.0)	48 (13.9)
Yes	1496 (91.3)	2132 (90.8)	654 (87.1)	1469 (87.7)	2106 (89.4)	1133 (80.1)	512 (81.0)	1449 (84.9)	91 (79.1)	73 (76.8)	45 (71.4)	166 (80.6)	43 (86.0)	92 (76.0)	298 (86.1)
Who ultimately makes care-seeking decisions															
Respond-ent alone	1337 (32.7)	548 (28.6)	229 (36.6)	461 (32.2)	600 (31.9)	343 (33.0)	172 (33.0)	416 (28.9)	28 (34.2)	14 (19.4)	16 (36.4)	49 (30.2)	10 (35.7)	18 (22.2)	61 (20.7)

Mod- Moderately.

	4 or more ANC visits, n=13888				2-3 ANC visits, n=8744				1 ANC visits, n=775				0 ANC visit, n=1027		
Variables	**Highest** *(facility birth & PNC).* *n* (%)	**High** (facility *birth, no PNC).* *n* (%)	**Slightly high** (*no facility birth, PNC).* *n* (%)	**Mod-low** *(no facility birth, no PNC).* n (%)	**Higher** *(facility birth, PNC).* *n (%)*	**Mod-high** *(facility birth, no PNC).* *n* (%)	**Mod-lower** *(no facility birth, PNC).* *n* (%)	**Very low** *(no facility birth, no PNC).* *n* (%)	**7th lowest** *(facility birth, PNC)* *n* (%)	**6th lowest** *(facility birth, no PNC)* *n* (%)	**5th lowest** *(no facility birth, PNC)* *n* (%)	**4th lowest** *(no facility birth, no PNC)* *n* (%)	**3rd lowest** *(facility birth, no PNC)* *n* (%)	**2nd lowest** *(no facility birth, PNC)* *n* (%)	**Lowest** *(no facility birth, no PNC)* *n* (%)
Both	1776 (43.5)	834 (43.4)	236 (37.8)	600 (41.9)	834 (44.3)	437 (42.1)	186 (35.7)	612 (42.4)	32 (39.0)	36 (50.0)	13 (29.6)	56 (34.6)	8 (28.6)	31 (38.3)	134 (45.6)
Husband alone	973 (23.8)	537 (28.0)	160 (25.0)	370 (25.9)	448 (23.8)	258 (24.9)	163 (31.3)	414 (28.7)	22 (26.8)	22 (30.6)	15 (34.1)	57 (35.2)	10 (35.7)	32 (39.5)	99 (33.7)
Parity															
Primiparous	1293 (26.1)	1388 (26.8)	96 (12.8)	324 (10.8)	555 (23.6)	715 (25.7)	68 (10.8)	295 (9.9)	32 (27.8)	53 (24.9)	10 (15.9)	53 (13.8)	28 (26.4)	13 (10.7)	98 (12.3)
Para 2-3	1877 (37.8)	2113 (40.8)	287 (38.2)	988 (33.0)	855 (36.3)	1061 (38.1)	219 (34.7)	906 (30.5)	28 (24.4)	72 (33.8)	16 (25.4)	108 (28.1)	33 (31.1)	36 (29.8)	200 (25.0)
Para 4+	1791 (36.1)	1678 (32.4)	369 (49.0)	1684 (56.2)	945 (40.1)	1006 (36.2)	345 (54.6)	1774 (59.6)	55 (47.8)	88 (41.3)	37 (58.7)	223 (58.1)	45 (42.5)	72 (59.5)	502 (62.7)
Wealth status															
Poor	1785 (36.0)	1739 (33.6)	497 (66.1)	1953 (65.2)	994 (42.2)	1181 (42.5)	446 (70.6)	2108 (70.9)	52 (45.2)	106 (49.8)	50 (47.2)	285 (74.2)	43 (68.3)	103 (85.1)	684 (85.5)
Middle	854 (17.2)	1031 (19.9)	132 (17.6)	556 (18.5)	457 (19.4)	565 (20.3)	127 (20.1)	498 (16.7)	24 (20.9)	44 (20.7)	20 (18.9)	60 (15.6)	10 (15.9)	15 (12.4)	51 (6.4)
Rich	2322 (46.8)	2409 (46.5)	123 (16.4)	487 (16.3)	904 (38.4)	1036 (37.2)	59 (9.3)	369 (12.4)	39 (33.9)	63 (29.6)	36 (34.9)	39 (10.29	10 (15.9)	3 (2.5)	65 (8.1)
Marital status															
Single	859 (17.3)	880 (17.0)	123 (16.4)	435 (14.5)	464 (19.7)	403 (20.6)	109 (17.3)	458 (15.4)	33 (28.7)	55 (25.8)	19 (30.2)	90 (23.4)	38 (35.9)	39 (32.2)	123 (15.4)
Married	4102 (82.7)	4299 (83.0)	629 (83.6)	2561 (85.5)	1891 (80.3)	1558 (79.5)	523 (82.7)	2517 (84.6)	82 (72.3)	158 (74.2)	44 (69.8)	294 (76.6)	68 (64.1)	82 (67.8)	677 (84.6)
Mass media exposure															

Mod- Moderately.

	4 or more ANC visits, n=13888				2-3 ANC visits, n=8744				1 ANC visits, n=775				0 ANC visit, n=1027		
Variables	**Highest** *(facility birth & PNC).* *n* (%)	**High** (facility *birth, no PNC).* *n* (%)	**Slightly high** (*no facility birth, PNC).* *n* (%)	**Mod-low** *(no facility birth, no PNC).* n (%)	**Higher** *(facility birth, PNC).* *n (%)*	**Mod-high** *(facility birth, no PNC).* *n* (%)	**Mod-lower** *(no facility birth, PNC).* *n* (%)	**Very low** *(no facility birth, no PNC).* *n* (%)	**7th lowest** *(facility birth, PNC)* *n* (%)	**6th lowest** *(facility birth, no PNC)* *n* (%)	**5th lowest** *(no facility birth, PNC)* *n* (%)	**4th lowest** *(no facility birth, no PNC)* *n* (%)	**3rd lowest** *(facility birth, no PNC)* *n* (%)	**2nd lowest** *(no facility birth, PNC)* *n* (%)	**Lowest** *(no facility birth, no PNC)* *n* (%)
No	804 (16.2)	484 (20.6)	733 (14.1)	521 (18.7)	204 (27.1)	993 (33.2)	176 (27.9)	1105 (37.1)	26 (22.6)	56 (26.3)	17 (27.0)	170 (44.3)	27 (25.5)	61 (50.4)	508 (36.6)
Yes	4157 (83.8)	1871 (79.4)	4446 (85.9)	2261 (81.3)	548 (72.9)	2001 (66.8)	456 (72.1)	1870 (62.9)	89 (77.4)	157 (72.7)	46 (73.0)	214 (55.7)	79 (74.5)	60 (49.6)	291 (36.4)

Mod- Moderately

Table 4 shows the results of the multinomial regressions for the associations between independent factors and different classes of care-seeking continuum from pregnancy to childbirth and 28 days postnatal, *lowest* class being reference category. Maternal primary or higher education levels compared to no formal education, were significantly associated with higher care-seeking behaviour in almost all care-seeking categories except among those who had 1 ANC visit/facility birth/no PNC *(6th lowest)* or less; relative risk ratios RRRs ranged from 2.1– 8.0, (95% confidence intervals [95% CI] 1.1–16.3). Similarly, trends were observed among those with husbands having primary education and above; RRRs ranged from 2.1– 6.4 (95% CI 1.3–10.6). Generally, the higher the level of education, the higher the care-seeking tendency. Exposure to mass media (radio/television) was generally associated with higher care-seeking tendency; RRRs ranged from 1.8– 3.2 (95% CI 1.2–5.4). There was minimal indication that desire to have a child improves care-seeking, although high RRR to seek care were observed among those who had 2 or more ANC visits, but findings were not statistically significant except in the *high* category.

Problem with distance to the health facility (versus no problem) was largely a demotivating factor to care-seeking. In 6 care-seeking categories, the RRRs ranged from 0.6 – 0.7 (95% CI 0.5–0.9), whereas in the remaining categories, *very low* to *lowest*, the association was marginally not statistically significant; RRRs ranged from 0.6 – 1.1 (95% CI 0.3–1.4). Higher parity versus primiparous was not associated with care-seeking except in a few care-seeking categories among those who had 2–3 ANC visits. Generally, being told about pregnancy and birth complications significantly increased the tendency to seek care in Kenya.

Older maternal age compared to young age was generally not significantly associated with care-seeking at all levels of care-seeking continuum, RRRs ranged from 0.4 – 0.9 (95% CI 0.3–1.7), except marginally significant in *moderately high* and *7th lowest* classes. Living in a rural area versus urban was significantly associated with lower care-seeking tendency in 9 categories. The remaining care-seeking categories indicated lower tendency but not significant results. Care-seeking was also notably hindered when the husband/partner rather than the woman made major decisions for maternal care-seeking in about 9 care-seeking categories. Being married showed variably and inconsistent associations with care-seeking, in most care-seeking classes, there was no significant association with care-seeking when compared to single mothers. Compared to the poor, the middle wealth status only showed significant higher care-seeking tendency in the first 4 higher care-seeking classes and 2 other

random classes, the rest were not statistically significant. Additionally, being rich indicated almost no significant association with care-seeking. Figure 4 summarizes in a forest plot, selected (extremes) results from table 4.

Table 4: Multinomial logistic regression showing relative risk ratios (RRR) for the associations between maternal and socio-demographic factors and maternal continuum of care-seeking behaviour in Kenya and Uganda, using demographic and health survey 2014-2016 data.

Variables	**Highest** *(≥4 ANC visits, facility birth & PNC).*	**Higher** *(2-3 ANC visits, facility birth, PNC).*	**High** (*≥4 ANC visits,* facility *birth, no PNC).*	**Mod-high** *(2-3 ANC visits, facility birth, no PNC).*	**Slightly high** (*≥4 ANC visits, no facility birth, PNC).*	**Mod-low** *(≥4 ANC visits, no facility birth, no PNC).*	**Mod-lower** *(2-3 ANC visits, no facility birth, PNC).*	**Very low** *(2-3 ANC visits, no facility birth, no PNC).*	**7th lowest** *(1 ANC visit, facility birth, PNC)*	**6th lowest** *(1 ANC visit, facility birth, no PNC)*	**5th lowest** *(1 ANC visit, no facility birth, PNC)*	**4th lowest** *(1 ANC visit, no facility birth, no PNC)*	**3rd lowest** *(No ANC visit, facility birth, no PNC)*	**2nd lowest** *(No ANC visits, no facility birth, PNC)*
Versus *lowest* (*no ANC, no facility birth, no PNC)* care-seeking level, 95% Confidence Interval (95%CI)														
Maternal education level														
No education	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Primary	3.2 (2.3-4.4)	3.2 (2.2,4.6)	3.4 (2.4-4.9)	2.7 (1.9-4.0)	2.1 (1.5-3.1)	2.3 (1.6-3.2)	2.1 (1.5-3.2)	2.8 (2.0-4.0)	2.6 (1.2-5.7)	1.5 (0.7-3.0)	1.7 (0.8-3.8)	1.7 (1.0-2.8)	2.6 (0.8-9.0)	0.9 (0.5-1.6)
Secondary & higher	8.0 (4.0-16.3)	6.9 (3.3-14.1)	6.9 (3.4,14.2)	4.9 (2.3-10.2)	2.5 (1.2-5.4)	3.1 (1.5-6.4)	3.9 (1.8-8.4)	2.9 (1.7-4.9)	3.4 (1.1-10.7)	1.7 (0.5-5.4)	2.1 (0.6-8.2)	1.5 (0.5-4.1)	4.3 (0.8,23.0)	0.6 (0.1-2.9)
Partner/husband education level														
No education	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Primary	3.3 (2.4-4.7)	3.4 (2.4-5.0)	3.6 (2.5-5.3)	4.7 (3.1-7.1)	2.6 (1.8-3.9)	2.1 (1.5-3.1)	2.7 (1.8-4.0)	2.7 (1.9-3.8)	3.4 (1.3-8.7)	1.9 (0.9-4.1)	1.9 (0.8-4.4)	2.5 (1.5-4.4)	–	1.2 (0.7-2.2)
Secondary & higher	6.4 (3.8-10.6)	5.5 (3.2-9.2)	6.2 (3.7-10.6)	7.2 (4.1-12.7)	3.7 (2.1-6.5)	3.0 (1.8-5.1)	3.4 (1.9-6.0)	2.9 (1.7-4.9)	6.0 (2.1-17.4)	2.3 (0.9-6.1)	2.1 (0.7-6.3)	3.3 (1.5-6.9)	–	1.2 (0.5-3.0)
Distance to nearest health facility is a big problem														
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	0.6 (0.5-0.8)	0.6 (0.5-0.8)	0.7 (0.5-0.9)	0.7 (0.5-0.9)	0.6 (0.5-0.8)	0.8 (0.6-1.0)	0.7 (0.5-0.9)	0.8 (0.6-1.1)	0.7 (0.4-1.2)	0.6 (0.3-1.0)	0.7 (0.4-1.3)	1.1 (0.7-1.6	0.6 (0.3-1.4)	0.8 (0.5-1.3)
Desire to have a child,														
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Mod- Moderately. Predictor variables mutually adjusted for each other.														

Variables	**Highest** *(≥4 ANC visits, facility birth & PNC).*	**Higher** *(2-3 ANC visits, facility birth, PNC).*	**High** (≥4 *ANC visits,* facility *birth, no PNC).*	**Mod-high** *(2-3 ANC visits, facility birth, no PNC).*	**Slightly high** (≥4 *ANC visits, no facility birth, PNC).*	**Mod-low** *(≥4 ANC visits, no facility birth, no PNC).*	**Mod-lower** *(2-3 ANC visits, no facility birth, PNC).*	**Very low** *(2-3 ANC visits, no facility birth, no PNC).*	**7th lowest** *(1 ANC visit, facility birth, PNC)*	**6th lowest** *(1 ANC visit, facility birth, no PNC)*	**5th lowest** *(1 ANC visit, no facility birth, PNC)*	**4th lowest** *(1 ANC visit, no facility birth, no PNC)*	**3rd lowest** *(No ANC visit, facility birth, no PNC)*	**2nd lowest** *(No ANC visits, no facility birth, PNC)*
Versus *lowest* (*no ANC, no facility birth, no PNC)* care-seeking level, 95% Confidence Interval (95%CI)														
Yes	1.5 (1.0-2.2)	1.3 (0.9-2.0)	1.6 (1.1-2.4)	1.2 (0.8-1.8)	1.3 (0.8-2.0)	1.4 (1.0-2.2)	0.9 (0.5-1.3)	1.3 (0.9-2.0)	0.7 (0.3-1.4)	0.8 (0.4-1.7)	0.5 (0.2-1.2)	1.0 (0.6-1.8)	0.5 (0.2-1.7)	0.4 (0.2-0.7)
Mass media exposure														
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	3.2 (2.4-4.2)	2.7 (2.0-3.6)	2.7 (2.0-3.6)	2.7 (2.0-3.7)	3.0 (2.2-4.1)	2.1 (1.6-2.8)	3.0 (2.2-4.2)	1.8 (1.4-2.4)	2.9 (1.6-5.4)	1.6 (0.9-3.0)	3.2 (1.6-6.3)	1.5 (1.0-2.4)	2.0 (0.8-4.8)	2.0 (1.2-3.2)
Told about pregnancy, birth complications (only Kenya) Versus *very low* care-seeking level														
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	–	–	–	–	–	–	–
Yes	2.6 (2.0-3.2)	1.7 (1.3-2.2)	2.1 (1.7-2.8)	1.1 (1.0-1.7)	2.0 (1.6-2.5)	1.2 (0.9-1.6)	1.5 (1.2-1.9)	–	–	–	–	–	–	–
Who ultimately makes care-seeking decisions														
Respond-ent alone	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Both	0.5 (0.4-0.8)	0.6 (0.4-0.8)	0.6 (0.4-0.9)	0.5 (0.4-0.8)	0.5 (0.3-0.7)	0.5 (0.4-0.8)	0.5 (0.3-0.7)	0.7 (0.5-0.9)	0.5 (0.3-0.9)	1.3 (0.6-2.5)	0.4 (0.2-0.9)	0.5 (0.3-0.9)	0.4 (0.1-1.0)	0.9 (0.5-1.7)
Husband alone	0.5 (0.4-0.7)	0.5 (0.4-0.7)	0.7 (0.5-0.9)	0.5 (0.3-0.7)	0.5 (0.3-0.7)	0.5 (0.3-0.7)	0.7 (0.4-1.0)	0.7 (0.5-0.9)	0.5 (0.3-1.0)	1.1 (0.5-2.5)	0.6 (0.3-1.4)	0.7 (0.4-1.2)	0.7 (0.3-1.8)	1.1 (0.6-2.2)
Maternal age (Years)														
15-24	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
25-34	0.9 (0.6-1.3)	0.7 (0.5-1.1)	0.6 (0.4-1.0)	0.6 (0.4-0.9)	0.9 (0.5-1.3)	0.6 (0.4-0.9)	0.9 (0.6-1.5)	0.6 (0.4-1.0)	0.4 (0.2-0.8)	0.8 (0.3-1.7)	0.4 (0.2-1.2)	0.5 (0.3-0.9)	0.5 (0.2-1.3)	0.5 (0.1-1.0)
35-49	0.8 0.5-1.3	0.6 (0.4-1.1)	0.6 (0.4-1.0)	0.5 (0.3-0.8)	0.9 (0.5-1.5)	0.5 (0.3-0.8)	0.8 (0.5-1.5)	0.6 (0.4-1.1)	0.4 (0.1-0.9)	0.9 (0.3-2.4)	0.8 (0.3-2.3)	0.6 (0.3-1.2)	0.3 (0.1-1.4)	0.3 (0.1-0.7)
Place of residence														

Mod- Moderately. Predictor variables mutually adjusted for each other

Variables	**Highest** *(≥4 ANC visits, facility birth & PNC).*	**Higher** *(2-3 ANC visits, facility birth, PNC).*	**High** *(≥4 ANC visits,* facility *birth, no PNC).*	**Mod-high** *(2-3 ANC visits, facility birth, no PNC).*	**Slightly high** *(≥4 ANC visits, no facility birth, PNC).*	**Mod-low** *(≥4 ANC visits, no facility birth, no PNC).*	**Mod-lower** *(2-3 ANC visits, no facility birth, PNC).*	**Very low** *(2-3 ANC visits, no facility birth, no PNC).*	**7th lowest** *(1 ANC visit, facility birth, PNC)*	**6th lowest** *(1 ANC visit, facility birth, no PNC)*	**5th lowest** *(1 ANC visit, no facility birth, PNC)*	**4th lowest** *(1 ANC visit, no facility birth, no PNC)*	**3rd lowest** *(No ANC visit, facility birth, no PNC)*	**2nd lowest** *(No ANC visits, no facility birth, PNC)*
Versus *lowest* (*no ANC, no facility birth, no PNC)* care-seeking level, 95% Confidence Interval (95%CI)														
Urban	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Rural	0.4 (0.2-0.6)	0.4 (0.2-0.6)	0.3 (0.2-0.5)	0.4 (0.3-0.7)	0.4 (0.2-0.6)	0.7 (0.4-1.1)	0.4 (0.2-0.6)	0.7 (0.4-1.1)	0.3 (0.2-0.7)	0.2 (0.1-0.4)	0.4 (0.2-1.0)	0.6 (0.3-1.2)	0.5 (0.2-1.5)	0.4 (0.2-0.8)
Marital status														
Single	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Married	1.9 (1.1-3.3)	1.7 (1.0-3.0)	2.0 (1.2-3.5)	2.0 (1.1-3.7)	0.6 (0.3-1.0)	2.4 (1.3-4.3)	0.5 (0.3-1.0)	1.6 (0.9-2.8)	1.5 (0.5-4.5)	1.9 (0.6-6.9)	0.3 (0.1-0.6)	1.9 (0.7-5.3)	1.0 (0.2-4.5)	0.2 (0.1-0.5)
Wealth status														
Poor	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Middle	1.8 (1.1-3.0)	2.0 (1.2-3.3)	2.2 (1.3-3.6)	1.9 (1.1-3.2)	1.3 (0.8-2.2)	1.9 (1.2-3.2)	1.3 (0.8-2.2)	1.5 (0.9-2.6)	2.7 (1.3-5.6)	2.6 (1.2-5.9)	1.4 (0.6-3.3)	1.8 (0.9-3.4)	1.7 (0.5-5.4)	0.9 (0.4-2.1)
Rich	1.3 (0.8-2.0)	1.2 (0.7-1.8)	1.2 (0.8-1.9)	1.1 (0.7-1.8)	0.4 (0.2-0.7)	0.8 (0.5-1.3)	0.2 (0.1-0.3)	0.6 (0.4-0.9)	1.1 (1.5-2.4)	1.3 (0.6-2.9)	0.3 (0.1-1.1)	0.4 (0.2-0.9)	1.2 (0.4-3.6)	0.1 (0.0-0.4)
Parity														
Primiparous	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Para 2-3	0.9 (0.6-1.5)	1.1 (0.6-1.8)	1.1 (0.6-1.7)	1.1 (0.6-1.8)	1.6 (0.9-2.8)	1.7 (1.0-2.9)	2.0 (1.1-3.6)	1.9 (1.1-3.2)	1.1 (0.5.2.7)	0.9 (0.3-2.3)	0.9 (0.3-2.6)	1.5 (0.7-3.3)	1.9 (0.5-6.8)	2.7 (1.0-7.6)
Para 4+	0.7 (0.4-1.2)	0.9 (0.5-1.6)	0.9 (0.5-1.6)	1.1 (0.6-1.9)	2.2 (0.6-2.2)	2.3 (1.3-4.0)	1.6 (0.8-3.1)	2.5 (1.4-4.5)	1.9 (0.7-5.2)	0.9 (0.3-2.7)	0.9 (0.3-3.1)	2.1 (0.9-5.1)	1.0 (0.2-4.9)	2.8 (0.9-8.4)
Mod- Moderately. Predictor variables mutually adjusted for each other														

Table 5 presents the odds ratios for the associations between continued care-seeking categories and neonatal mortality, with the *highest* category as the reference class. Figure 5 shows a forest plot of adjusted odds ratios (aOR) for overall results in Table 5. Overall, *3rd lowest* and *lowest* categories were associated with about 4-folds odds of neonatal mortality, aOR 4.2, (95% CI_{range} 1.6–10.9). For joint Kenya and Uganda, *moderately high and very low* levels of care-seeking also showed significant higher odds of neonatal death; aOR ranged 1.9 – 2.4 for the two classes. However, the remaining two categories *(4^{th} lowest and moderately low)* did not indicate any statistically significant association with mortality. For Kenya only, *lowest*, *very low, moderately low, moderately high,* and *high* versus *highest* were all significantly associated with neonatal deaths and neonates in the *lowest* class were 6 times likely to die. For Uganda, only *very low* category was significantly associated with neonatal death, aOR 1.7 (95% CI 1.1-2.7) and *lowest* class showed higher odds but was marginally not significant aOR 2.5 (95% CI 1.0-6.0). We observe that the proportion of Ugandan mothers seeking continued care at highest level were more than twice (33.8%) that of Kenya (13.4%)

Table 5: Crude and adjusted odds ratios for the association between classes of care-seeking behavior in continuum of care and neonatal mortality in Kenya and Uganda, using demographic and health survey 2014-2016 data.

Classes of care-seeking behaviour	Overall Crude odds ratio (95% CI) n=22538	Overall aOR* (95% CI)	Proportion of the total in Kenya (%) n=12579	Kenya only aOR* (95% CI)	Proport-ion of the total in Uganda (%) n=9959	Uganda only aOR* (95% CI)
Highest *(≥4 ANC visits, health facility birth, yes PNC).*	Ref.	Ref.	(13.4)	Ref.	(33.8)	Ref.
Higher *(2-3 ANC visits, Health facility birth, yes PNC). Mis=47*	1.5 (1.0-2.4)	1.3 (0.7-2.2)	(6.1)	1.4 (0.4-4.2)	(16.3)	0.9 (0.5-1.5)
High *(≥4 ANC visits, Health facility birth, no PNC). Mis=72*	1.5 (1.0-2.2)	1.5 (1.0-2.3)	(29.8)	2.9 (1.4-6.0)	(15.6)	1.0 (0.6-1.7)
Moderately high *(2-3 ANC visits, health facility birth and no PNC). Mis=33*	2.4 (1.6-3.7)	2.2 (1.4-3.4)	(16.0)	3.4 (1.6-7.4)	(8.4)	1.6 (0.9-2.7)
Moderately low *(≥4 ANC visits, no facility birth, no PNC). Mis=44*	1.3 (0.8-2.1)	1.3 (0.8-2.2)	(14.5)	2.6 (1.2-5.9)	(12.4)	0.8 (0.4-1.4)
Very low *(2-3 ANC visits, no facility birth, no PNC). Mis=48*	1.9 (1.3-2.8)	1.9 (1.3-2.9)	(14.7)	2.8 (1.3-6.2)	(12.0)	1.7 (1.1-2.7)
4^{th} lowest *(1 ANC visit, no health facility births, no PNC) Mis=2*	2.2 (0.7-6.7)	2.2 (0.7-7.3)	(2.1)	–	(1.2)	–
3^{rd} lowest *(No ANC, health facility births and no PNC). Mis=2*	7.8 (3.5-17.5)	4.2 (1.6-10.9)	(0.5)	–	(0.4)	–
Lowest *(No ANC, no facility births and no PNC.). Mis=17*	4.5 (2.5-7.8)	4.2 (2.3-7.8)	(5.6)	6.0 (2.6-13.6)	(1.5)	2.5 (1.0-6.5)

*adjusted/restricted to birthweight ≥ 2500 g and singleton births. *Mis – Missing: Due to non-response, proportionally (relatively random) distributed across all strata.*

Still in Table 5, in combined country findings, comparing *higher* and *moderately high* classes both with 2-3 ANC visits and facility childbirth, the only difference is lack of PNC attendance in the *moderately high* class indicating that lack of PNC contributes significantly to neonatal deaths, aOR 2.2 (95% CI 1.4-3.4). Similarly, in Kenya with 16% of mothers in this (*moderately high)* category, aOR 3.4 (95% CI 1.6-7.4). In Uganda only about 8% of mothers were in this category. It can generally be observed that care-seeking tendencies are higher in Uganda compared to Kenya, with mothers seeking care at *highest* level more than doubles that of Kenya (33.8% versus 13.4%). Similarly, at *lowest* level Uganda is more than thrice lower than Kenya (1.5% versus 5.6%)

Figure 6 below shows that overall, for both Kenya and Uganda, 23% neonatal deaths were attributable to inadequate maternal care-seeking during pregnancy, childbirth and 28 days postnatal period in the Kenya and Uganda. Insufficient care seeking within *lowest* and *3rd lowest* care-seekers accounted for almost 3-quarters (75%) of neonatal deaths in those groups. About 9% of neonatal deaths in Kenya and Uganda could be attributable to home births, no PNC visits and inadequate ANC visits.

Discussion

Although 95% of mothers initiated the first ANC visit in Kenya and Uganda, only about 20% completed recommended (modified) care attendance of 4 or more ANC visits, health facility birth and at least 1 PNC visit within 28 days after birth. Despite the relatively free or subsidized maternity costs in first level facilities in Uganda and Kenya, several factors still exert profound influence on care-seeking behaviour along the continuum of care that consequently impact neonatal survival. Overall, being educated indicated the highest odds of continual care-seeking, and parental education was 2–8 times associated with continued care-seeking in most of the care-seeking categories. The higher the education level, the higher tendency to seek care. Our results concur with other studies that have shown associations between education and uptake of ANC [57, 58], institutional birth [57, 59] and PNC [60]. Further, consistent with our findings, studies have reported higher utilization of obstetric care among mothers exposed to mass media [61]. Being told of pregnancy complications also improved care-seeking (in Kenya). Over 23% of neonatal deaths in Kenya and Uganda would be prevented if mothers adhered to recommended care attendance. Desire to have a child, parity and being married did not show any consistent associations with continued care-

seeking behaviour. Advance maternal age indicated lower tendency to seek care, but the findings were not statistically significant.

Conversely, a husband as the main or joint decision maker concerning maternal health care-seeking was generally a significant demotivating factors to care-seeking among the women in Kenya and Uganda. Although our study could not examine this further, other studies have shown that gender inequality, negative sociocultural factors and women's financial marginalization tend to hinder women´s independent decision making in health care especially in low-and middle-income settings [62, 63]. Over 80% of the mothers in this study were married and over 70% lived in rural areas, meaning most women are housewives with subsistence farming as source of livelihood. Thus maternal dependency on the husbands to seek care revolves mainly around financial support for repeated transportation and minor hospital expenses and this can hinder a woman´s decision to seek care. This partly explains why being married did not indicate consistent significance to care-seeking.

Also, congruent with our findings, a systematic review in Africa by Dahab et al. reported lack of women autonomy in health decisions as major hindrance to maternity care-seeking [64]. However, a study in Nepal, a similar social setting reported that a complex balance between women´s independence in maternity decision making and husband´s involvement can enhance maternity care-seeking [65]. Living in rural compared to urban and longer distance to the nearest health facility largely indicated lower tendency to care-seeking, this was especially true (significant) among relatively high care-seeking classes. However, the associations were not statistically significant among mostly lower care-seekers. In agreement with most of our findings, two systematic reviews also found longer distance to health facility [64] and rural residency [58] as factors that impede care-seeking. Being rich did not show any significant association with higher tendency to seek care as would be expected, however, the use of cumulative living standard and assets possessed to determine wealth status does not translate to having liquid cash, readily available to support care-seeking. Further research on a valid method to determine wealth status that incorporates monetary availability could be explored.

The far-reaching impacts of maternal and sociodemographic factors on maternal care-seeking continuum necessitate both short and long-term solutions with overarching implications for policy improvements. The 2030 Sustainable Development Goals (SDG) 4, 5 and 10 that

focus on inclusive education and gender equality and reducing inequalities resonate closely with most of the recommendations emanating from our findings. In the long-term, strengthening education for all with purposeful emphasis on maternity care-seeking should be integrated into the educational curriculum. A recent systematic review in SSA recommended female education as a strong enabling factor for ANC visits [20]. Improving knowledge and skills for all will inculcate women-led maternal health-decision making and create a supportive social environment that would enhance completion of the care-seeking continuum. In the short-term, health promotion for maternal care seeking among pregnant or nursing mothers will improve utilization and consequently greater neonatal survival.

The positive correlations between ANC and facility birth and PNC found in figure 2 indicate that even the first contact with health personnel can improve continued care utilization and these findings concur with other studies [66, 67]. The *3rd lowest* and *lowest* categories with no ANC, no PNC and only facility birth in the *3rd lowest* accounted for 76% of within-category neonatal deaths each, and a total of 7.0% deaths in the total population. Even though these two *lowest* categories had the highest within-category attributable mortality risks, they contributed relatively lower population attributable deaths partly because there were rather fewer mothers in these categories. In comparison, the mothers in the *very low* and *moderately high* categories with 2-3 ANC visits, no PNC plus facility birth only in the *moderately high* class accounted for relatively lower within-category deaths each (50%), however they accounted for more neonatal deaths in Kenya/Uganda population (16%) since relatively more mothers were in this category.

Given the findings in Figure 5, the results of the first 3 care-seeking classes *(higher, high, moderately high)* and last 2 classes *(3rd lowest, lowest)* seem to corroborate theoretical expectations in the `hierarchy´ of consequences of inadequate care-seeking. However, the odds for neonatal mortality in class 4 *(moderately low)* and class 6 *(4th lowest)* were not statistically significant for neonatal deaths as would be expected. Notably, in table 5, the *moderately low* with ≥ 4 ANC visits and no facility birth and no PNC showed significant association with neonatal death in Kenya but not Uganda. A possible explanation would be that the quality of ANC given in Uganda was perhaps better and protective than in Kenya. We could not deduce any possible explanations from our findings for why the odds ratio in

the *4th lowest* compared to the *highest* class was not statistical significance despite the low level of care received.

Further, in table 5, the only difference in care-seeking between *higher* and *moderately high* categories (versus *highest* class) *is* lack of PNC in the latter class. Thus, the statistical significance in the odds for mortality in the *moderately high* class and not in the *higher* class reveal that PNC could be very protective and is critical for neonatal survival. Our findings show that PNC is the least attended-to component of care continuum. WHO and other studies also agree that PNC is a crucial phase yet most neglected part of care [68, 69]. We recommend strategies that enhance PNC utilization in Kenya and Uganda. One such strategy would be to emphasize PNC right from the first ANC contact, which has not been the case. PNC attendance existed only in the checklists for fourth ANC visit in the focused ANC recommendations in both Kenya and Uganda [70, 71]. This implied that majority of mothers with less than 4 ANC visits got very limited information that could induce PNC attendance. The current WHO guidelines for 8 ANC visits recommends emphasis on continuity of care including PNC, however it is not clear on how PNC utilization would be promoted during ANC visits in non-midwife-led continuity of care models such as Kenya and Uganda and other LMIC if it is not clearly specified [72]. The twice higher proportion of Uganda women in the *highest* category than Kenya could be attributable to the fact that Uganda abolition of user fees in 2001 took place much earlier than in Kenya (2013).

Although it was not possible for our study to determine attributable mortality risks for each specific care component, nonetheless, we can deduce that over 23 % of neonatal deaths in Kenya and Uganda could be avoided through basic maternal and newborn care recommendations prior to 2016. We can also reason that if Kenya and Uganda would fully implement the current WHO recommendations of 8 ANC visits, it would lead to higher rates of facility births and ensure PNC as indicated in figure 2, then much higher proportions of neonatal deaths would be eliminated.

For mothers with problems with distance to the nearest health facility, strengthening, structuring, and funding the community health workers strategy to engage families, community and health facilities could help align care-seeking continuum especially for PNC that is currently poorly attended. The Village health workers (VHTs)in parts of Uganda for example have achieved profound improvement in promoting maternal care-seeking [73].

However, high attrition rate is a major challenge to community health workers (CHW) programs such as VHTs in Uganda due to poor governmental support (74). Given the readily available telephone communication in East Arica, the integration of mobile health or mHealth programme specifically for maternal care-seeking in the existing mHealth structure in Kenya [75] and Uganda [76] is another viable approach. A cost-free two-way mHealth messaging approach could facilitate follow up, counter sociodemographic barriers, and profoundly improve continued care-seeking. Engaging the CHW in this endeavor would be feasible with minimal extra investment.

Studies in Kenya and Uganda reported increased utilization of ANC and delivery services due to free maternity policy [77-79]. Reports evaluating impacts of free maternity policies in Kenya and Uganda highlight increase of ANC coverage and health facility births but almost no mention is made of the impact on PNC [40, 80]. Other studies have reported that free maternity policy increased mainly facility births [81, 82]. The universal health policy in Uganda and the *Linda mama* strategy [83] in Kenya advocate for universal access to quality maternity health services but do not offer transportation for poor mothers or health providers in/to remote areas, yet most mothers are rural dwellers. Additionally, there are hidden hospital charges due to underfunding or delayed distribution of funds [39, 41, 43].

Another worthwhile strategy to improve continued maternity care utilization among mothers would be to develop a standard questionnaire or a protocol for estimating the level of continued care-seeking based on a brief interview of the mother at first ANC visit. The results could be used to determine the degree of follow-up that can be employed to close the care-seeking gap. Such questionnaires have previously been used in to assess health seeking behaviour in sexual transmitted diseases for example [84]. It could be based on identified cluster of items including sociodemographic factors that impact care-seeking behaviours that after prolonged testing and validation could be shortened using factor analysis. Previous maternity history of care-seeking continuum could also be used to improve such a standard. Poor care-seeking mothers can then be enrolled in a messaging list or maternity mHealth programme. This can be a less-costly health promotion strategy that could easily be integrated in ANC setup in low-resourced health care settings.

Methodological considerations

The large sample size of the maternal and child data of the latest Kenya and Uganda DHS, which are nationally representative allowed for valid stratified analysis for deeper understanding of neonatal health and survival. The study is thus externally valid and generalizable in other similar settings. Like many cross-sectional surveys, recall bias may not be completely eliminated from the study. Nonetheless, by selecting the most recent live births for analysis and because childbirth is a special occurrence that mothers may not easily forget within a short period of time, our findings considerably reflect the reality of maternal care and associated neonatal survival in these countries.

A strength to our study was the use of directed acyclic graphs that enabled us to explicitly map the predictor-outcome relationship for well guided analysis and identification of possible confounders. Our study could not examine other factors such as poor attitude of nurses and lack of information on health care services offered which have been found by both quantitative and qualitative studies to hinder care utilization in low- and middle-income countries [85, 86]. Another limitation to our study was that inadequate facilities and drugs have also been associated with poor care-seeking, but our data did not capture these specific aspects [87]. In addition, the cross-sectional survey design of the DHS dataset does not allow collection of data on quality of care. Our study did not incorporate factors such as intimate partner violence (IPV) which prevalent in many countries, IPV is known to be associated with poor care-seeking behaviour [88]. Further studies can investigate this.

Conclusion

Further multi-country large-scale population-based research and systematic reviews could enable development and use of a brief standard questionnaire to determine a mother´s continued care-seeking level during the first ANC visit and use the information to close the care-seeking gaps where it´s most needed. This is especially viable in LMIC with limited health workforce. Similar standard questionnaires have been used previously in other areas to assess care-seeking behaviour [89, 90]. The use of mobile health (mHealth) specifically for promoting continued maternal care utilization up to postnatal can be integrated in the existing structures. Strengthening the existing community health workers system to be integral part of promoting continued maternal care-seeking could enhance care-seeking as a stand-alone strategy or as a component of the above suggested strategies.

Acknowledgments

Much appreciation to the DHS programme and partners for availing the datasets for this study.

Competing interest statement

No competing interests were reported by the authors.

Ethics and dissemination

DHS data collection process and storage guaranteed the anonymity and confidentiality of participants. Datasets are publicly available and permission for access and use was obtained after sending to the request to the DHS secretariat.

Funding

No funds were obtained from any entity or industry by the authors of this study.

Authors' contributions

MOA conceptualized, designed, obtained data for the study, conducted analysis, interpreted the results, drafted, and reviewed the manuscript. BOA and AA interpreted the results and conducted critical review of the manuscript. The final draft was agreed upon by all authors.

Data sharing statement: https://dhsprogram.com/data/available-datasets.cfm

References

1. United Nations Inter-Agency Child Mortality Estimation. Levels and trends in child mortality 2020 [Available from: https://www.unicef.org/media/79371/file/UN-IGME-child-mortality-report-2020.pdf . (accessed Jan 2021)
2. Neonatal Mortality. Neonatal period is the most vulnerable time for a child [Internet]. UNICEF. 2020 [cited January 2021]. Available from: https://data.unicef.org/topic/child-survival/neonatal-mortality/. (accessed Jan 2021)
3. World Health Organization. Newborn death and illness 2011 [Available from: https://www.who.int/pmnch/media/press_materials/fs/fs_newborndealth_illness/en/.
4. World Health Organization. Newborn death and illness 2005 [Available from: https://www.who.int/pmnch/media/press_materials/fs/fs_newborndealth_illness/en/. (accessed Jan 2021)
5. World Health Organization. Newborns: improving survival and well-being: key facts 2021 [Available from: https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality. (accessed Jan 2021)
6. World Health Organization. Positive experiences, key to antenatal care uptake and quality 2019 [Available from: https://www.who.int/reproductivehealth/antenatal-care-uptake/en/. (accessed Jan 2021)
7. World Health Organization. Newborns: improving survival and well-being 2020 [Available from: https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality. (accessed Jan 2021)
8. Swedish Public Health Agency (Folkhälsomyndigheten). Infant mortality (Spädbarnsdödlighet) 2019 [Available from: https://www.folkhalsomyndigheten.se/folkhalsorapportering-statistik/tolkad-rapportering/folkhalsans-utveckling/resultat/halsa/spadbarnsdodlighet/. (accessed Jan 2021)
9. UN IGME. Levels and trends in child mortality report 2019. Estimates developed by the UN Inter-agency Group for Child Mortality Estimation. 2019.
10. Tessema ZT, Yazachew L, Tesema GA, Teshale AB. Determinants of postnatal care utilization in sub-Saharan Africa: a meta and multilevel analysis of data from 36 sub-Saharan countries. Ital J Pediatr. 2020;46(1):175.
11. Tran TK, Nguyen CT, Nguyen HD, Eriksson B, Bondjers G, Gottvall K, et al. Urban - rural disparities in antenatal care utilization: a study of two cohorts of pregnant women in Vietnam. BMC Health Serv Res. 2011;11:120.
12. Doctor HV, Nkhana-Salimu S, Abdulsalam-Anibilowo M. Health facility delivery in sub-Saharan Africa: successes, challenges, and implications for the 2030 development agenda. BMC Public Health. 2018;18(1):765.
13. World Health Organization. Make every mother and child count. Geneva, Switzerland; 2005.
14. Kerber KJ, de Graft-Johnson JE, Bhutta ZA, Okong P, Starrs A, Lawn JE. Continuum of care for maternal, newborn, and child health: from slogan to service delivery. Lancet. 2007;370(9595):1358-69.
15. Benova L, Dennis ML, Lange IL, Campbell OMR, Waiswa P, Haemmerli M, et al. Two decades of antenatal and delivery care in Uganda: a cross-sectional study using Demographic and Health Surveys. BMC Health Serv Res. 2018;18(1):758.
16. Kichamu G AJ, Karimurio L. Maternal and Child Health: Demographic and health survey.
17. Moller AB, Petzold M, Chou D, Say L. Early antenatal care visit: a systematic analysis of regional and global levels and trends of coverage from 1990 to 2013. Lancet Glob Health. 2017;5(10):e977-e83.

18. Gilson L, McIntyre D. Removing user fees for primary care in Africa: the need for careful action. Bmj. 2005;331(7519):762-5.
19. Andersen R, Newman JF. Societal and individual determinants of medical care utilization in the United States. Milbank Mem Fund Q Health Soc. 1973;51(1):95-124.
20. Okedo-Alex IN, Akamike IC, Ezeanosike OB, Uneke CJ. Determinants of antenatal care utilisation in sub-Saharan Africa: a systematic review. BMJ Open. 2019;9(10):e031890.
21. Neupane B, Rijal S, G CS, Basnet TB. Andersen's model on determining the factors associated with antenatal care services in Nepal: an evidence-based analysis of Nepal demographic and health survey 2016. BMC Pregnancy Childbirth. 2020;20(1):308.
22. Jadoon B, Mahaini R, Gholbzouri K. Determinants of over and underuse of caesarean births in the Eastern Mediterranean Region: an updated review. East Mediterr Health J. 2019;25(11):837-46.
23. Gu H, You H, Yan Z, Yang N, Kou Y, Sun J, et al. Determinants of the utilization of postpartum family visits: Evidence from rural areas of Eastern China. PLoS One. 2018;13(3):e0194061.
24. Shitie A, Assefa N, Dhressa M, Dilnessa T. Completion and Factors Associated with Maternity Continuum of Care among Mothers Who Gave Birth in the Last One Year in Enemay District, Northwest Ethiopia. J Pregnancy. 2020;2020:7019676.
25. Oh J, Moon J, Choi JW, Kim K. Factors associated with the continuum of care for maternal, newborn and child health in The Gambia: a cross-sectional study using Demographic and Health Survey 2013. BMJ Open. 2020;10(11):e036516.
26. Mohan D, LeFevre AE, George A, Mpembeni R, Bazant E, Rusibamayila N, et al. Analysis of dropout across the continuum of maternal health care in Tanzania: findings from a cross-sectional household survey. Health Policy Plan. 2017;32(6):791-9.
27. Downe S, Finlayson K, Tunçalp Ö, Gülmezoglu AM. Provision and uptake of routine antenatal services: a qualitative evidence synthesis. Cochrane Database Syst Rev. 2019;6(6):Cd012392.
28. World Health Organization. Africa´s newborns–counting them and making them count. [Available from: https://www.who.int/pmnch/media/publications/aonsection_I.pdf. (accessed Jan 2021)
29. Masaba BB, Mmusi-Phetoe RM. Neonatal Survival in Sub-Sahara: A Review of Kenya and South Africa. J Multidiscip Healthc. 2020;13:709-16.
30. The World Bank. Open Data, indicators, neonatal (per 1000 live births)-Kenya, Uganda, Rwanda. 1994–2019. 2021 [February 2021]. Available from: https://data.worldbank.org/indicator/SH.DYN.NMRT?locations=KE-UG-RW. (accessed Jan 2021)
31. Kenya National Bureau of Statistics. 2019 Kenya Population and Housing Census.: Distribution of population by socio-economic characteristics. 2019.
32. Uganda Bureau of Statistics (UBOS). 2020 Statistics abstract. 2020.
33. Uganda National Web Portal. Agriculture 2021 [March 2021]. Available from: https://www.gou.go.ug/content/agriculture. (accessed Jan 2021)
34. The World Bank. Open data source: Agriculture and Rural Development 2021 [March 2021]. Available from: https://data.worldbank.org/topic/agriculture-and-rural-development?locations=KE-UG. (accessed Jan 2021)
35. Uganda Bureau of Statistics (UBOS). Population and Census 2020 [March 2020]. Available from: https://www.ubos.org/explore-statistics/20/.(accessed Jan 2021)
36. The World Bank. Open data source: Life expectancy at birth, females - Kenya, Uganda [March 2021]. Available from: https://data.worldbank.org/indicator/SP.DYN.LE00.FE.IN?locations=KE-UG. (accessed Jan 2021)

37. Leone T, Cetorelli V, Neal S, Matthews Z. Financial accessibility and user fee reforms for maternal healthcare in five sub-Saharan countries: a quasi-experimental analysis. BMJ Open. 2016;6(1):e009692.
38. Ministry of health. Situation analysis of newborn health in Uganda: current status and opportunities to improve care and survival. Kampala: Government of Uganda. Save the Children, UNICEF,WHO. 2008.
39. Masaba BB, Mmusi-Phetoe RM. Free Maternal Health Care Policy in Kenya; Level of Utilization and Barriers. International Journal of Africa Nursing Sciences. 2020;13:100234.
40. Odokonyero T MF, Adong A, et al. Universal health coverage in Uganda: The critical health infrastructure, healthcare coverage and equity. 2017.
41. Ministry of health. Linda Mama Programme positioning Kenya on the Pathway to UHC, Health PS.
42. Ross AB, DeStigter KK, Rielly M, Souza S, Morey GE, Nelson M, et al. A low-cost ultrasound program leads to increased antenatal clinic visits and attended deliveries at a health care clinic in rural Uganda. PLoS One. 2013;8(10):e78450.
43. Kenya National Commission on Human rights. Implementing free maternal health care in Kenya. 2013.
44. Croft TA, MJ. Allen, K. et al.,. Guide to DHS Statistics. Rockville Maryland, USA:_ICF. 2018.
45. ICF International. Demographic and Health Survey: Interviewer´s manual. 2019: Rockville, Maryland.
46. Asamoah BO, Agardh A, Cromley EK. Spatial analysis of skilled birth attendant utilization in Ghana. Glob J Health Sci. 2014;6(4):117-27.
47. Sandberg J, Odberg Pettersson K, Asp G, Kabakyenga J, Agardh A. Inadequate knowledge of neonatal danger signs among recently delivered women in southwestern rural Uganda: a community survey. PLoS One. 2014;9(5):e97253.
48. Fisseha G, Berhane Y, Worku A, Terefe W. Distance from health facility and mothers' perception of quality related to skilled delivery service utilization in northern Ethiopia. Int J Womens Health. 2017;9:749-56.
49. Mwilike B, Nalwadda G, Kagawa M, Malima K, Mselle L, Horiuchi S. Knowledge of danger signs during pregnancy and subsequent healthcare seeking actions among women in Urban Tanzania: a cross-sectional study. BMC Pregnancy Childbirth. 2018;18(1):4.
50. Asp G, Odberg Pettersson K, Sandberg J, Kabakyenga J, Agardh A. Associations between mass media exposure and birth preparedness among women in southwestern Uganda: a community-based survey. Glob Health Action. 2014;7:22904.
51. Ahinkorah BO, Budu E, Seidu AA, Agbaglo E, Adu C, Ameyaw EK, et al. Barriers to healthcare access and healthcare seeking for childhood illnesses among childbearing women in sub-Saharan Africa: A multilevel modelling of Demographic and Health Surveys. PLoS One. 2021;16(2):e0244395.
52. Adedokun ST, Yaya S. Factors influencing mothers' health care seeking behaviour for their children: evidence from 31 countries in sub-Saharan Africa. BMC Health Serv Res. 2020;20(1):842.
53. Chakraborty NM, Fry K, Behl R, Longfield K. Simplified Asset Indices to Measure Wealth and Equity in Health Programs: A Reliability and Validity Analysis Using Survey Data From 16 Countries. Glob Health Sci Pract. 2016;4(1):141-54.
54. Textor J ZBV, Gilthorpe M.K, et al. Robust causal inference using directed acyclic graphs: the R package 'dagitty'.
. International Journal of Epidemiology 2016;45(9):1887-94.

55. Vilanova CS, Hirakata VN, de Souza Buriol VC, Nunes M, Goldani MZ, da Silva CH. The relationship between the different low birth weight strata of newborns with infant mortality and the influence of the main health determinants in the extreme south of Brazil. Popul Health Metr. 2019;17(1):15.
56. Magee BD. Role of multiple births in very low birth weight and infant mortality. J Reprod Med. 2004;49(10):812-6.
57. Enos JY, Amoako RD, Doku IK. Utilization, Predictors and Gaps in the Continuum of Care for Maternal and Newborn Health in Ghana. Int J MCH AIDS. 2021;10(1):98-108.
58. Tekelab T, Chojenta C, Smith R, Loxton D. Factors affecting utilization of antenatal care in Ethiopia: A systematic review and meta-analysis. PLoS One. 2019;14(4):e0214848.
59. Nigusie A, Azale T, Yitayal M. Institutional delivery service utilization and associated factors in Ethiopia: a systematic review and META-analysis. BMC Pregnancy Childbirth. 2020;20(1):364.
60. Tolera H, Gebre-Egziabher T, Kloos H. Risk factors for women's non-utilization of decentralized primary health care facilities for postnatal care in rural western Ethiopia. Ther Adv Reprod Health. 2020;14:2633494120928340.
61. Acharya D, Khanal V, Singh JK, Adhikari M, Gautam S. Impact of mass media on the utilization of antenatal care services among women of rural community in Nepal. BMC Res Notes. 2015;8:345.
62. Sumankuuro J, Crockett J, Wang S. Sociocultural barriers to maternity services delivery: a qualitative meta-synthesis of the literature. Public Health. 2018;157:77-85.
63. Ganle JK, Obeng B, Segbefia AY, Mwinyuri V, Yeboah JY, Baatiema L. How intra-familial decision-making affects women's access to, and use of maternal healthcare services in Ghana: a qualitative study. BMC Pregnancy Childbirth. 2015;15:173.
64. Dahab R, Sakellariou D. Barriers to Accessing Maternal Care in Low Income Countries in Africa: A Systematic Review. Int J Environ Res Public Health. 2020;17(12).
65. Thapa DK, Niehof A. Women's autonomy and husbands' involvement in maternal health care in Nepal. Soc Sci Med. 2013;93:1-10.
66. Fekadu GA, Kassa GM, Berhe AK, Muche AA, Katiso NA. The effect of antenatal care on use of institutional delivery service and postnatal care in Ethiopia: a systematic review and meta-analysis. BMC Health Serv Res. 2018;18(1):577.
67. Atuhaire R, Atuhaire LK, Wamala R, Nansubuga E. Interrelationships between early antenatal care, health facility delivery and early postnatal care among women in Uganda: a structural equation analysis. Glob Health Action. 2020;13(1):1830463.
68. Tiruneh GT, Worku A, Berhane Y, Betemariam W, Demissie M. Determinants of postnatal care utilization in Ethiopia: a multilevel analysis. BMC Pregnancy Childbirth. 2020;20(1):549.
69. World Health Organization. WHO recommendations on postnatal care of the mother and newborn. Geneva, Switzerland: World health Organization; 2014.
70. Ministry of health. Essential Maternal and Newborn Clinical Care Guidelines For Uganda. 2016.
71. Services MoPHaSaMoM. National Guidelines for quality obstetrics and perinatal care
72. World Health Organization. WHO recommendatons on antenatal for a positive pregnancy experience. 2016.
73. Fund UNC. Village health teams, key structures in saving mothers and their babies from preventable deaths 2018 [Available from: https://www.unicef.org/uganda/stories/village-health-teams-key-structures-saving-mothers-and-their-babies-preventable-deaths. (accessed Jan 2021)

74. Agarwal S, Abuya T, Kintu R, Mwanga D, Obadha M, Pandya S, et al. Understanding community health worker incentive preferences in Uganda using a discrete choice experiment. J Glob Health. 2021;11:07005.
75. Kenya Moh-. Kenya Standards and Guidelines for mHealth Systems. 2017.
76. Kamulegeya LH, Ssebwana J, Abigaba W, Bwanika JM, Musinguzi D, editors. Mobile Health in Uganda: A Case Study of the Medical Concierge Group2019.
77. Lang'at E, Mwanri L, Temmerman M. Effects of implementing free maternity service policy in Kenya: an interrupted time series analysis. BMC Health Serv Res. 2019;19(1):645.
78. Atuoye KN, Barnes E, Lee M, Zhang LZ. Maternal health services utilisation among primigravidas in Uganda: what did the MDGs deliver? Global Health. 2020;16(1):40.
79. Njuguna J, Kamau N, Muruka C. Impact of free delivery policy on utilization of maternal health services in county referral hospitals in Kenya. BMC Health Serv Res. 2017;17(1):429.
80. Abuya T DM, Amanda D et al. Impacts of removing user fees for maternal health services on universal health coverage in Kenya. 2018.
81. Tama E, Molyneux S, Waweru E, Tsofa B, Chuma J, Barasa E. Examining the Implementation of the Free Maternity Services Policy in Kenya: A Mixed Methods Process Evaluation. Int J Health Policy Manag. 2018;7(7):603-13.
82. Gitobu CM, Gichangi PB, Mwanda WO. The effect of Kenya's free maternal health care policy on the utilization of health facility delivery services and maternal and neonatal mortality in public health facilities. BMC Pregnancy Childbirth. 2018;18(1):77.
83. Ministry of Health Kenya. Linda Mama Programme positioning Kenya on the Pathway to UHC, Health PS, 2020.
84. World Health Organization. A rapid assessment of health seeking behaviour in relation to sexually transmitted disease. 1995.
85. Nachinab GT, Adjei CA, Ziba FA, Asamoah R, Attafuah PA. Exploring the Determinants of Antenatal Care Services Uptake: A Qualitative Study among Women in a Rural Community in Northern Ghana. J Pregnancy. 2019;2019:3532749.
86. Kyei-Nimakoh M, Carolan-Olah M, McCann TV. Access barriers to obstetric care at health facilities in sub-Saharan Africa-a systematic review. Syst Rev. 2017;6(1):110.
87. Xu K, Evans DB, Kadama P, Nabyonga J, Ogwal PO, Nabukhonzo P, et al. Understanding the impact of eliminating user fees: utilization and catastrophic health expenditures in Uganda. Soc Sci Med. 2006;62(4):866-76.
88. Musa A, Chojenta C, Geleto A, Loxton D. The associations between intimate partner violence and maternal health care service utilization: a systematic review and meta-analysis. BMC Womens Health. 2019;19(1):36.
89. Stack RJ, Mallen CD, Deighton C, Kiely P, Shaw KL, Booth A, et al. The development and initial validation of a questionnaire to measure help-seeking behaviour in patients with new onset rheumatoid arthritis. Health Expect. 2015;18(6):2340-55.
90. World Health Organization. Draft protocol. A rapid assessment of health seeking behaviour in relation to sexually transmitted disease. 1995.

Figures and supplementary files

Figure legends

Figure 1: Proportions of antenatal care visits by number of ANC contacts in Kenya and Uganda, using demographic and health survey 2014-2016 data.

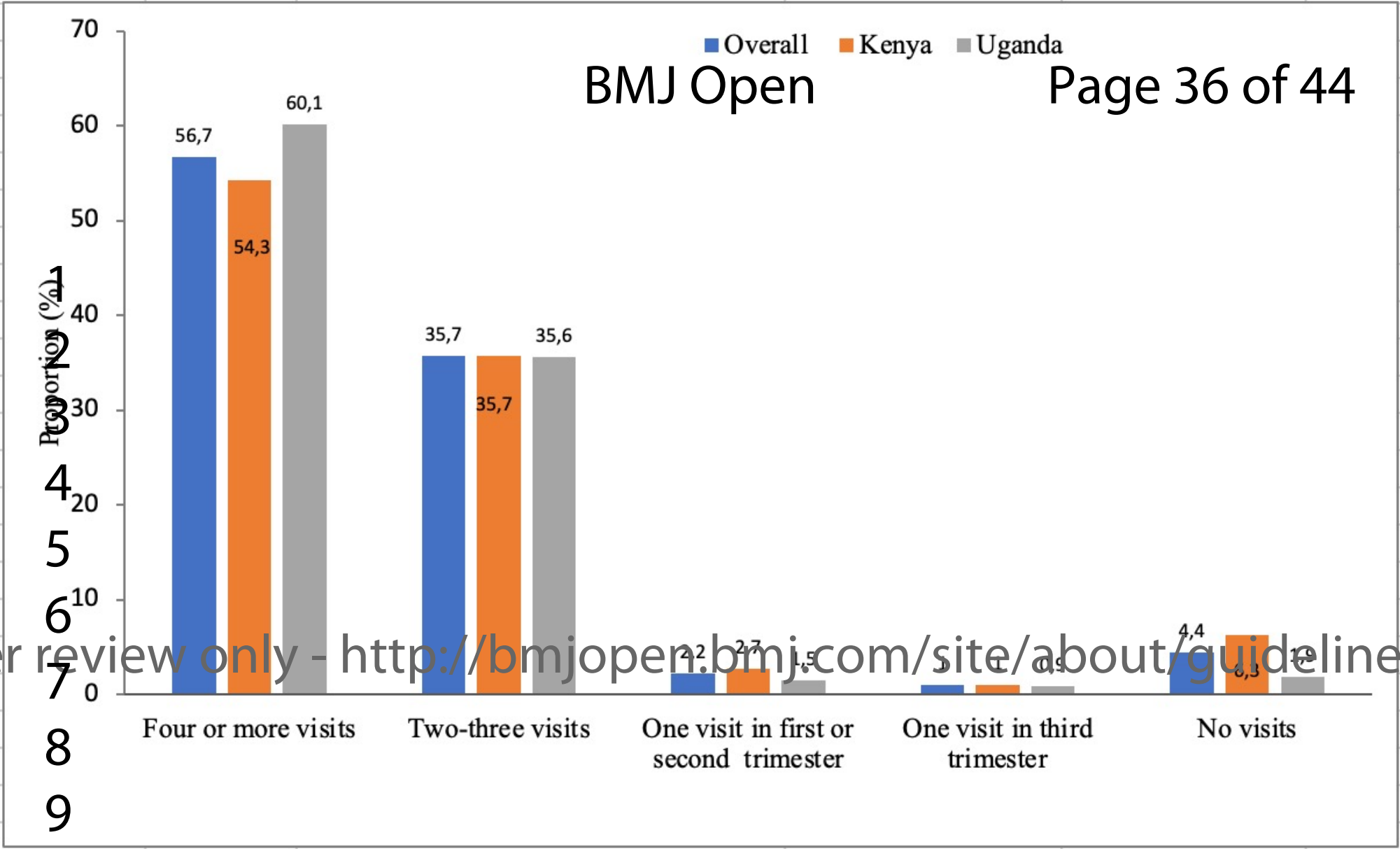
Figure 2. A scatter plot showing correlation between number of antenatal care visits and proportions of facility births and postnatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

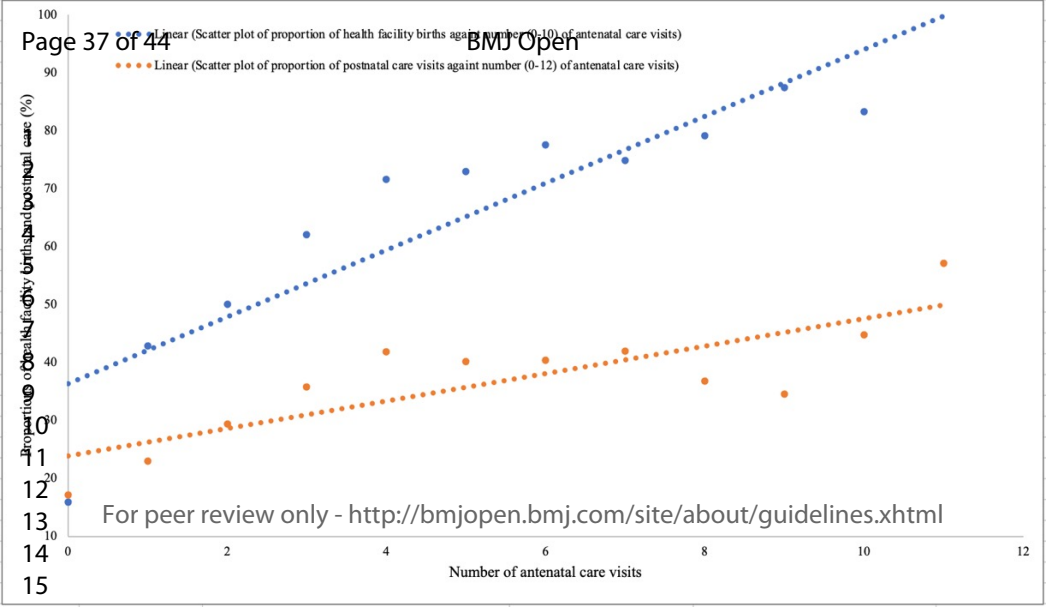
Figure 3. Proportion of hospital and home births by number of antenatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

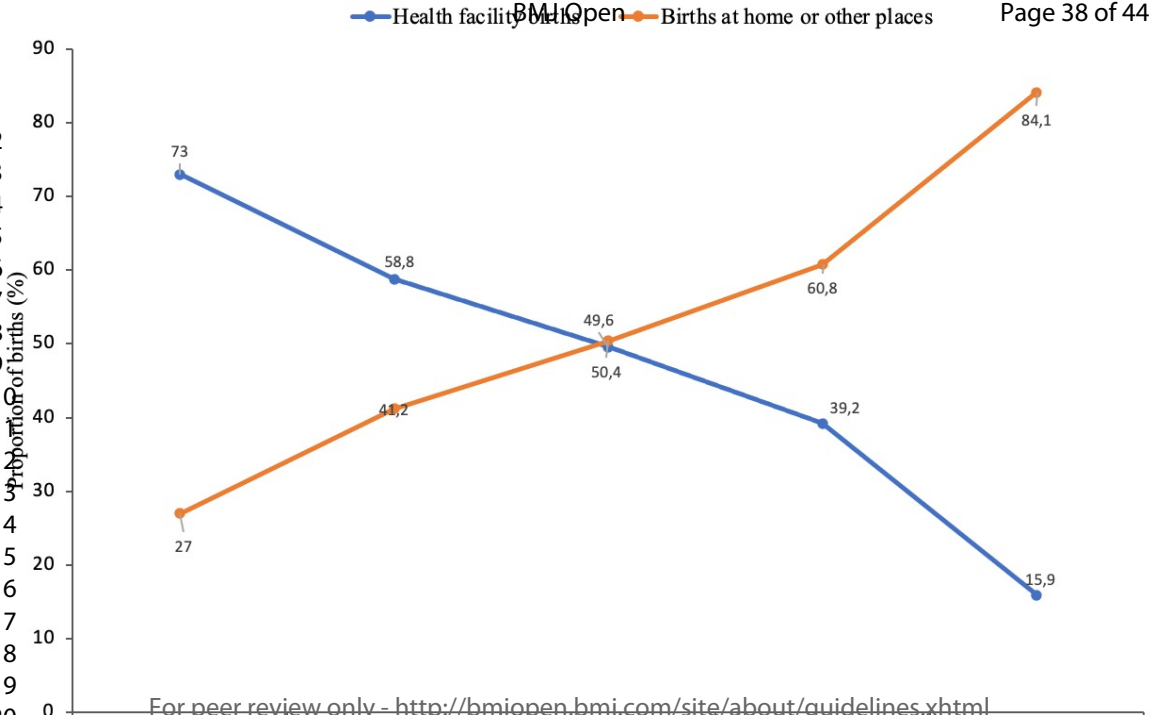
Figure 4: showing relative risk ratios (RRR) for the associations between maternal and socio-demographic factors and maternal continuum of care-seeking behaviour in Kenya and Uganda, using demographic and health survey 2014-2016 data

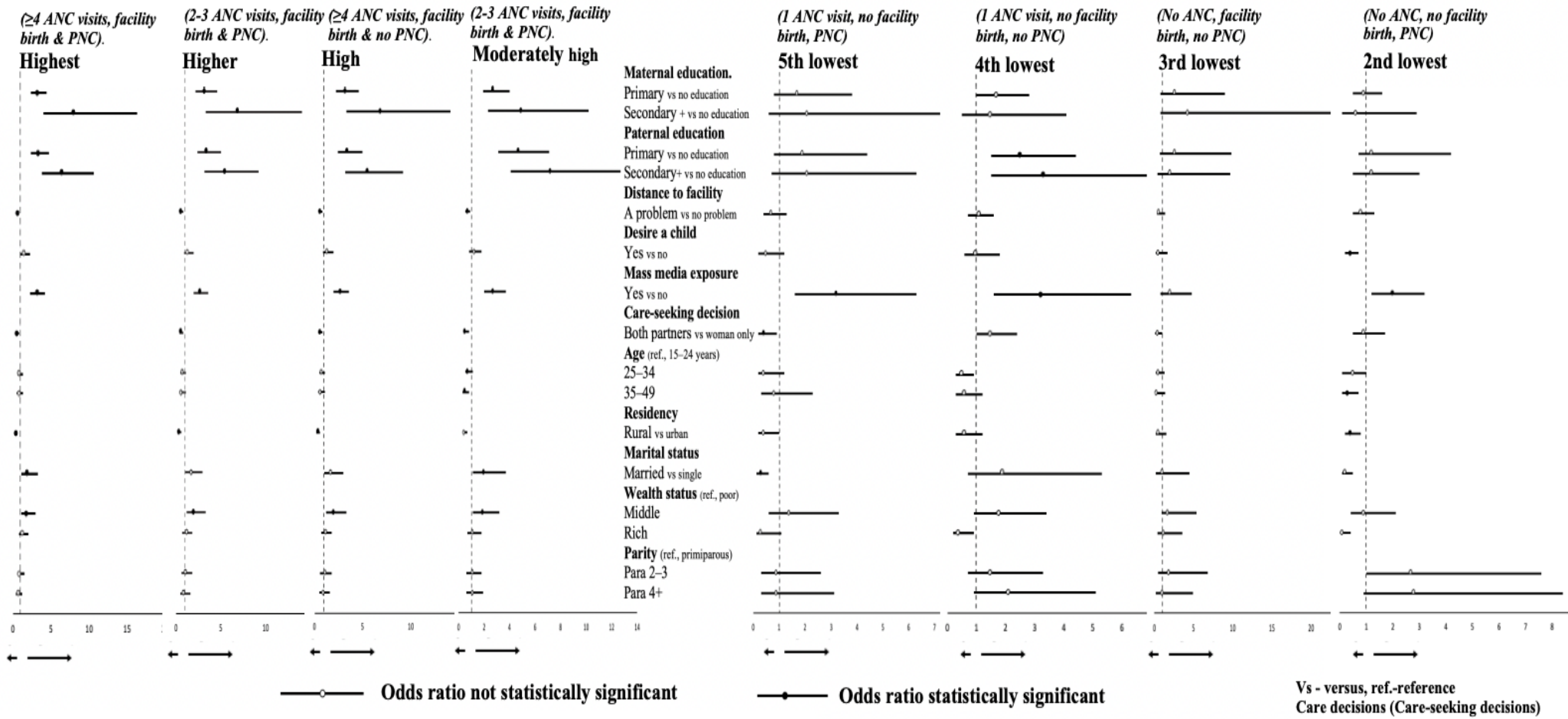
Figure 5: A forest plot showing adjusted odds ratios between continued care-seeking behavioral classes/levels and neonatal mortality, using Kenya and Uganda, 2014-2016 demographic and health survey data.

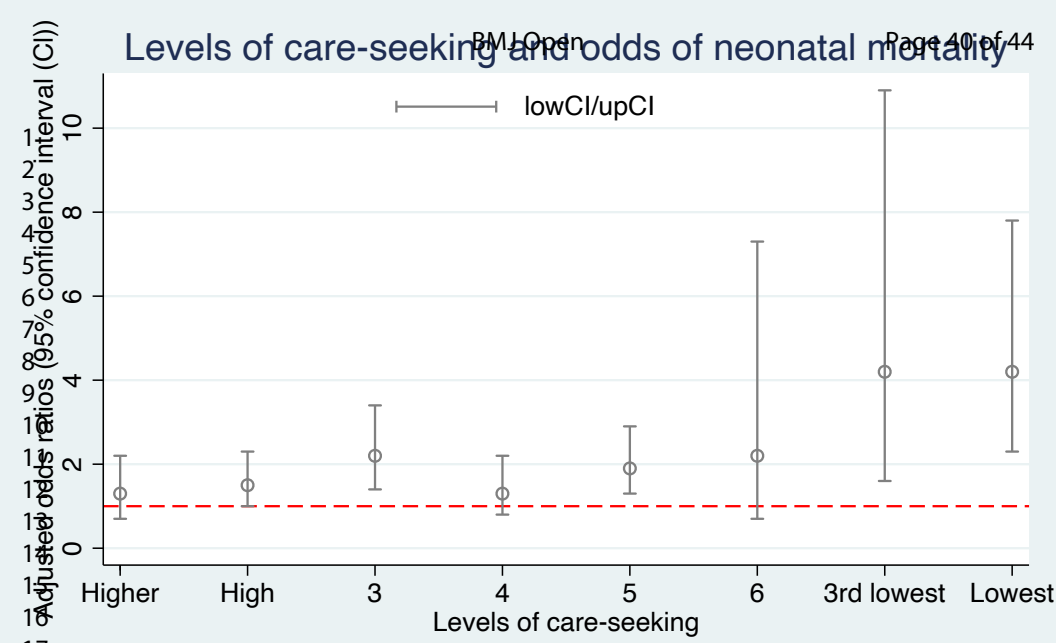
Figure 6: Attributable and population attributable neonatal mortality risk proportion for lower categories of care-seeking in Kenya and Uganda, using demographic and health survey 2014-2016 data

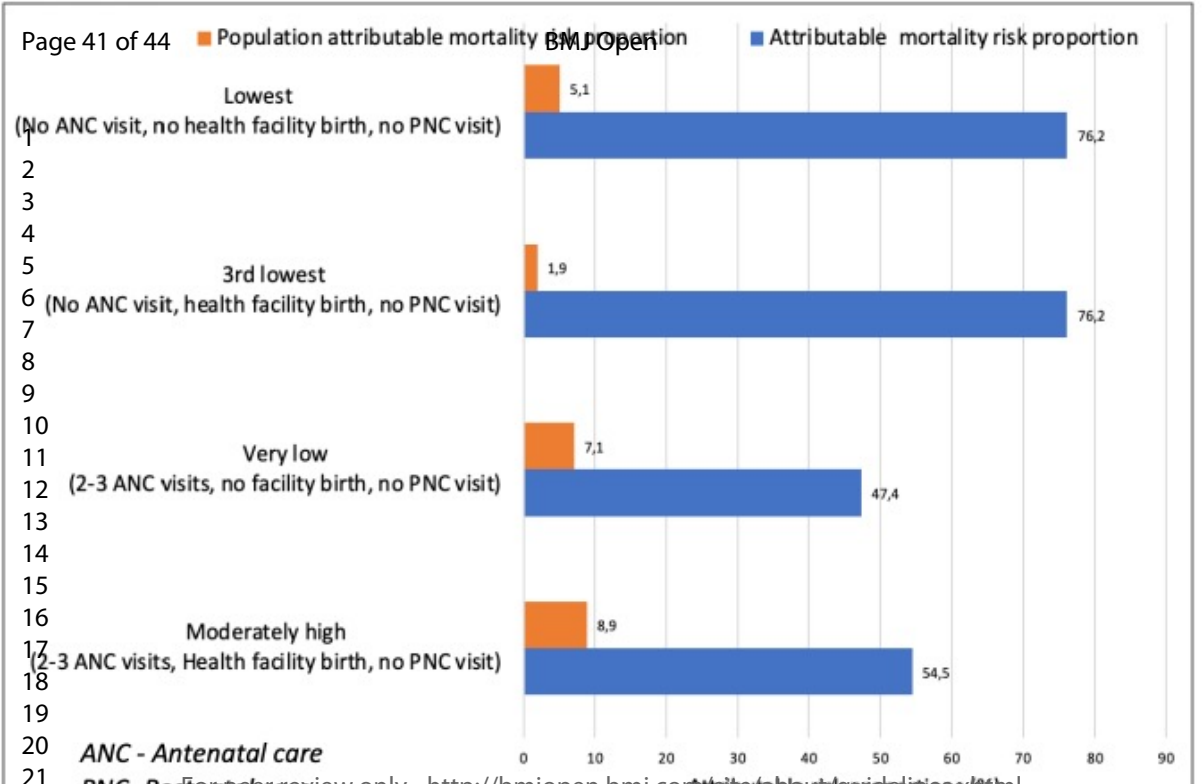







(≥4 ANC visits, facility birth & PNC).
Highest
(2-3 ANC visits, facility birth & PNC).
Higher
(≥4 ANC visits, facility birth & no PNC).
High
(2-3 ANC visits, facility birth & PNC).
Moderately high
(1 ANC visit, no facility birth, PNC)
5th lowest
(1 ANC visit, no facility birth, no PNC)
4th lowest
(No ANC, facility birth, no PNC)
3rd lowest
(No ANC, no facility birth, PNC)
2nd lowest
Maternal education.
Primary vs no education
Secondary + vs no education
Paternal education
Primary vs no education
Secondary+ vs no education
Distance to facility
A problem vs no problem
Desire a child
Yes vs no
Mass media exposure
Yes vs no
Care-seeking decision
Both partners vs woman only
Age (ref., 15–24 years)
25–34
35–49
Residency
Rural vs urban
Marital status
Married vs single
Wealth status (ref., poor)
Middle
Rich
Parity (ref., primiparous)
Para 2–3
Para 4+
Odds ratio not statistically significant
Odds ratio statistically significant
Vs - versus, ref.-reference
Care decisions (Care-seeking decisions)





ANC - Antenatal care

PNC -Postnatal care

Supplementary file 1.

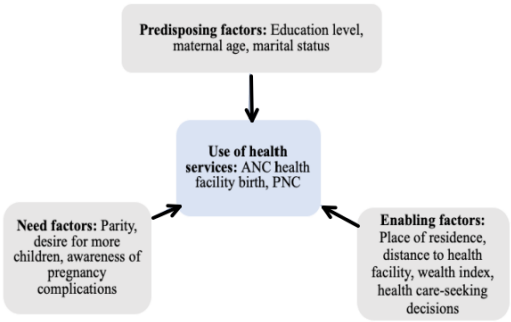


Figure showing behavioral model of utilization of health care services, modified from Andersen and Newman model.

Supplementary file 2.

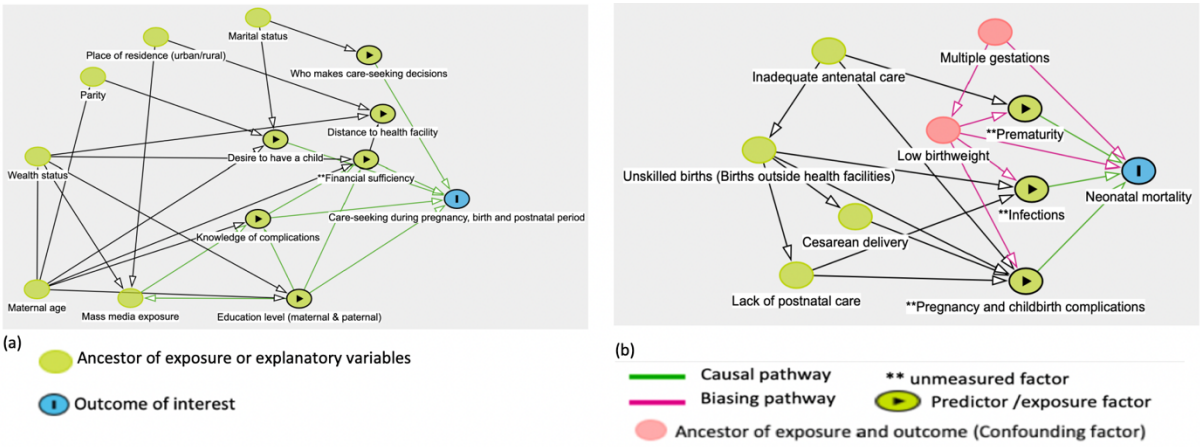


Figure 1: Directed acyclic graphs showing the predictor–outcome relationship for both care-seeking and neonatal survival in Kenya and Uganda, *(Developed from www.dagitty.net, using DAGitty version 3.0.)*

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Page 1, line 3. Page 2, line 5.
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found. Page 2, lines 1-28.
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 4, lines 1-34. And page 5 lines 1-27.
Objectives	3	State specific objectives, including any prespecified hypotheses. Page 5, Lines 24-27.
Methods		
Study design	4	Present key elements of study design early in the paper. Page 6, lines 14-22.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection. Page 5 line 31-34, Page 6 lines 1-22.
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Page 6, lines 15-22.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable. Page 6, lines 25-34. Page 7, lines 1-28. Page 8, lines 1-21
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Page 6, lines 15-22. Page 7, lines 1-28. Page 8, lines 1-20.
Bias	9	Describe any efforts to address potential sources of bias. Page 8, lines 15-30. Page 9, lines 1-16.
Study size	10	Explain how the study size was arrived at. N/A. Described for primary data collector, Page 6, 15-22
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why. Page 6, lines 26-34, Page 7, lines 1-28. Page 8, lines 1-21. Page 8. Page 9, 1-16.
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding. Page 8, lines 24-34. Page 9, lines 1-2.
		(*b*) Describe any methods used to examine subgroups and interactions. Page 8, lines 24-34. Page 9, lines 4-5.
		(*c*) Explain how missing data were addressed, Page 9, lines 11-15
		(*d*) If applicable, describe analytical methods taking account of sampling strategy. Page 9, 11-12.
		(*e*) Describe any sensitivity analyses, Subgroup analysis- Page 9, line 3-5.
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Page 10, table 2, lines 5-18, Pages 11, 12, 13, 14 table 4. Page 20 table 5
		(b) Give reasons for non-participation at each stage. Page 9, line 10-16. Page 20 table 5
		(c) Consider use of a flow diagram-N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and

		information on exposures and potential confounders. Page 9-14, table 2 and table 4
		(b) Indicate number of participants with missing data for each variable of interest. Page 20, table 5, Page 9, lines 10-15.
Outcome data	15*	Report numbers of outcome events or summary measures. Page 6, lines 26-34. Page 7, lines 1-18. Page 20 table 5.
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included. Page 17-19, table 4. Page 20, table 5. Page 20, lines 1-14. Page 21, lines 4-5.
		(*b*) Report category boundaries when continuous variables were categorized. N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period. Attributable risk fraction (difference between absolute risks in two groups) Page 9, lines 20-24 and Figure 6.
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses. Page 9, lines 4-5. Subgroup analysis- Page 20 table 5
Discussion		
Key results	18	Summarise key results with reference to study objectives. Page 21, lines 19-33. Page 22, lines 1-19. Page 23, lines 1-22.
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. Page 25, lines 1-21.
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. Discussion section, pages 21-25
Generalisability	21	Discuss the generalisability (external validity) of the study results. Page 26, lines 4-5
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based. Page 27, line 14

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.