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Journal:	BMJ Open
Manuscript ID	bmjopen-2021-054136
Article Type:	Original research
Date Submitted by the Author:	03-Jun-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. Asamoah, Benedict ; Lund University, Social Medicine and Global Health, Department of Clinical Sciences, Malmö
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.

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Abstract

Objectives: To examine how maternal and sociodemographic factors determine maternal careseeking 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 subnationally 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

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

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

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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 1 st contact in 3 rd trimester n=533	1 ANC visit and 1 st contact in 1st or 2 nd trimester n=240	0 ANC visit, n=1095
Health facility h	oirth (%)				
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

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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 careseeking behaviour from pregnancy to postnatal period. Majority (\geq 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.

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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 0	or more ANC	visits, n=13	888	2-3 ANC visits, n=8744				1 ANC visit in 3 rd trimester , n=533	1 ANC visit, in 1st or 2 nd trimester , n=240	0 ANC visit, n=1095	
Maternal & sociodemogr aphic 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(%)	'Unstrate gic'- lowest (°Some facility births and ^d some PNC). n (%)	2 nd lowest (Health facility birth, ^e some PNC). n(%)	Lowes t (No health facility births, ^f some PNC) n(%)
Maternal age (· · · · · · · · · · · · · · · · · · ·											
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
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
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
Place of reside	ence			·								1
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(1
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(8 .7)
Distance to nea	earest health	facility is a p	roblem	·							1 -)	1
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(4
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(5

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Lowes

t (No

health

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births,

fsome

PNC)

n(%)

551(59

336(36

41(4.4

228(54 .2)

154(36 .6)

39(9.3

.4)

.2)

0 ANC visit, n=1095

2nd

lowest

(Health

facility

birth.

^esome

PNC).

n(%)

33(18.8)

99(56.3)

44(25.0)

14(18.7)

44(58.7)

17(22.7)

1 ANC

visit in

trimester

Strategic-

, n=533

lowest

(^aSome

facility

^bsome

PNC).

n(%)

births and

123(22.7)

332(61.4)

86(15.9)

45(17.3)

149(57.3)

66(25.4)

127(71.4)

51(28.6)

3rd

Very low

(No

health

facility

PNC).

n (%)

birth, no

726(24.4)

1960(65.9

289(9.7)

259(17.5)

938(63.5)

280(19.0)

351(66.9)

174(33.1)

1 ANC

visit, in

1st or 2nd

trimester

`Unstrate

, n=240

gic'-

lowest

(^cSome

facility

^dsome

(%)

PNC). n

94(38.1)

127(51.4)

26(10.5)

33(25.4)

69(53.1)

28(21.5)

41(55.4)

33(44.6)

births and

	4	or more ANC	2 visits, n=13	2-3 ANC visits, n=8744			
Maternal & sociodemogr aphic 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(%)
Maternal edu	cation level	1	1	1	1	1	I
No education	435(8.8)	389(7.5)	167(22.2)	811(27.1)	241(10.2)	271(9.8)	140(22.2)
Primary	2535(51.1	2721(52.5)	486(64.6)	1789(59.7)	1369(58.2)	1645(59.1)	399(63.1)
Secondary & higher	1991(40.1	2069(40.0)	99(13.2)	396(13.2)	745(31.6)	866(31.1)	93(14.7)
Partner/husba	and education	on level	•				1
No education	255(6.1)	128(6.5)	118(16.9)	276(19.1)	142(7.4)	68(6.5)	98(16.8)
Primary	1860(44.6	991(50.3)	401(57.5)	815(56.5)	1011(52.4)	590(56.2)	348(59.8)
Secondary & higher	2059(49.3	851(43.2)	179(25.6)	352(24.4)	777(40.2)	392(37.3)	136(23.4)
Knowledge ab	out pregna	ncy, birth com	plications (only Kenya)			
No	537(32.8)	319(39.1)	348(47.4)	286(63.4)	341(45.6)	250(53.7)	349(55.6)
Yes	1099(67.2	496(60.9)	386(52.6)	165(36.6)	407(54.4)	216(46.3)	279(44.4)

	4	or more ANC	' visits, n=13	888		2-3 ANC vis	its, n=8744		1 ANC visit in 3 rd trimester , n=533	1 ANC visit, in 1st or 2 nd trimester , n=240	0 ANC vi n=1095	sit,
Maternal & sociodemogr aphic 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(%)	[•] Unstrate gic'- lowest (^c Some facility births and ^d some PNC). n (%)	2 nd lowest (Health facility birth, ^e some PNC). n(%)	Lowes t (No health facility births, fsome PNC) n(%)
Some – a propo	ortion within	that specific c	ategory: a39	%, ^b 25%, ^c 50%	, ^d 19%, ^e 39%, [.]	$f13\%.$ $1^{st}-fi$	rst, 2^{nd} – secon	d			Mod – Mo	oderatel
Desire to have	a child,											
Desire to have No	a child, 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
	1	215(9.2) 2132(90.8)	97(12.9) 654(87.1)	206(12.3) 1469(87.7)	249(10.6) 2106(89.4)	153(11.9) 1133(80.1)	120(19.0) 512(81.0)	257(15.1) 1449(84.9)	72(22.1) 254(77.9)	33(19.8) 134(80.2)	18(15) 102(85)	5)
No	142(8.7) 1496(91.3)	2132(90.8)	654(87.1)	<u> </u>		, <i>,</i> ,	, í	<u> </u>		, í	, í	5) 396(8
No Yes	142(8.7) 1496(91.3)	2132(90.8)	654(87.1)	<u> </u>		, <i>, ,</i>	, í	<u> </u>		, í	, í	5) 396(8
No Yes Who ultimatel Respondent alone	142(8.7) 1496(91.3) ly makes car	2132(90.8) re-seeking dec	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)	5) 396(8 .5) 81(21
No Yes Who ultimate Respondent alone (woman)	142(8.7) 1496(91.3) ly makes car 1337(32.7)	2132(90.8) re-seeking dec 548(28.6)	654(87.1) eisions 229(36.6)	461(32.2)	2106(89.4) 600(31.9)	1133(80.1) 343(33.0)	512(81.0)	1449(84.9) 416(28.9)	254(77.9) 75(30.6)	134(80.2) 35(28.0)	102(85) 24(33.3)	5) 396(8 .5) 81(21 3) 168(4 .1) 132(3
No Yes Who ultimatel Respondent alone (woman) Both Husband alone	142(8.7) 1496(91.3) Iy makes can 1337(32.7) 1776(43.5)	2132(90.8) re-seeking dec 548(28.6) 834(43.4)	654(87.1) cisions 229(36.6) 236(37.8)	1469(87.7) 461(32.2) 600(41.9)	2106(89.4) 600(31.9) 834(44.3)	1133(80.1) 343(33.0) 437(42.1)	512(81.0) 172(33.0) 186(35.7)	1449(84.9) 416(28.9) 612(42.4)	254(77.9) 75(30.6) 87(35.5)	134(80.2) 35(28.0) 56(44.8)	102(85) 24(33.3) 23(31.9)	5) 396(8 .5) 81(21 3) 168(4 .1)
No Yes Who ultimatel Respondent alone (woman) Both Husband	142(8.7) 1496(91.3) Iy makes can 1337(32.7) 1776(43.5)	2132(90.8) re-seeking dec 548(28.6) 834(43.4)	654(87.1) cisions 229(36.6) 236(37.8)	1469(87.7) 461(32.2) 600(41.9)	2106(89.4) 600(31.9) 834(44.3)	1133(80.1) 343(33.0) 437(42.1)	512(81.0) 172(33.0) 186(35.7)	1449(84.9) 416(28.9) 612(42.4)	254(77.9) 75(30.6) 87(35.5)	134(80.2) 35(28.0) 56(44.8)	102(85) 24(33.3) 23(31.9)	5) 396(3 .5) 81(2 3) 168(4 .1) 132(2

	4	or more ANC	visits, n=13	888	2-3 ANC visits, n=8744				1 ANC1 ANCvisit invisit, in3rd1st or 2ndtrimestertrimester, n=533, n=240			
Maternal & sociodemogr aphic 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(%)	'Unstrate gic'- lowest (°Some facility births and ^d some PNC). n (%)	2 nd lowest (Health facility birth, ^e some PNC). n(%)	Lowes t (No health facility births, fsome 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(6
Some – a propo Wealth status		that specific c	ategory: ^a 399	9%, ^b 25%, ^c 50%,	, ^d 19%, ^e 39%, ^f	⁵ 13%. 1 st – fit	rst, 2 nd – secon	d			Mod – Mo	oderate
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(
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
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
Marital status	\$									-		
	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.
Single	1	1	1									

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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 careseeking 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 careseeking 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.

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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 &	Highest	Higher	High	Mod- high	Slightly	Mod-low	Mod-lower	Very low	Strategic-	`Unstrategic'-	2 nd lowes
sociodemogr-	(≥4 ANC	(2-3 ANC	$(\geq 4 ANC)$	(2-3 ANC	high	(≥4 ANC	(2-3 ANC	(2-3 ANC	lowest	lowest (1 ANC	(No ANC
aphic	visits,	visits,	visits,	visits, health	$(\geq 4 ANC$	visits, No	visits, no	visits, No	(1 ANC visit,	visit, 1 st	visit,
characteristi-	health	Health	health	facility birth,	visits, No	health	health	health	1 st contact in	contact in 1 st	health
cs	facility	facility	facility	no PNC).	health	facility	facility birth,	facility	3 rd trimester,	or 2^{nd}	facility
	birth &	delivery,	birth, no		facility birth,	birth, no	PNC).	birth, no	^a some facility	trimester,	birth,
	PNC).	PNC)	PNC).		PNC).	PNC).		PNC).	births and	^c some facility	^e some
			0.						^b some PNC)	<i>births and dsome PNC</i>)	PNC).
		1	V	ersus lowest car	e-seeking level,	95% Confider	nce Interval (95%	ωCI)	1		1
Maternal educ	ation level						,	,			
No education	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Primary	3.2	3.2	3.4	2.8	2.2	2.3	2.2	2.8	2.1	1.2	2.6
-	(2.4-4.3)	(2.4-4.4)	(2.5-4.7)	(2.0-3.9)	(1.5-3.0)	(1.7-3.1)	(1.5-3.1)	(2.1-3.8)	(1.4-3.3)	(0.7-2.0)	(1.3-5.4)
Secondary &	8.6	7.4	7.4	5.2	2.7	3.4	4.2	3.3	2.7	1.3	3.0
higher	(4.6-16.0)	(3.9-13.9)	(3.9-14.1)	(2.7-10.1)	(1.4-5.3)	(1.8-6.4)	(2.1-8.3)	(1.7-6.2)	(1.2-6.0)	(0.5-3.3)	(1.0-9.4)
Partner´s educ									•		
No education	Ref.		Ref.	Ref.		Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Primary	3.3	3.4	3.6	4.5	2.6	2.1	2.6	2.6	2.4	2.1	1.7
	(2.4-4.5)	(2.5-4.8)	(2.6-5.0)	(3.1-6.7)	(1.8-3.7)	(1.6-2.9)	(1.8-3.7)	(1.9-3.5)	(1.5-3.9)	(1.2-3.7)	(0.8-3.7)
Secondary &	6.0	5.1(3.3-	5.9	6.8(4.1-11.1)	3.5(2.1-5.7)	2.8(1.8-	3.1(1.9-5.2)	2.7(1.7-	3.4(1.8-6.2)	2.6(1.2-5.4)	1.6(0.6-
higher	(3.9-9.3)	8.1)	(3.7-9.3)			4.4)		4.2)			4.1)
Distance to nea	1		blem	<u>.</u>		1	1	1	a	1	
No	Ref.	Ref	Ref.	Ref.		Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes (A big	0.6	0.6	0.7	0.7	0.6	0.8	0.7	0.8	0.7	1.0	0.5
problem)	(0.5-0.7)	(0.5-0.8)	(0.5-0.8)	(0.5-0.9)	(0.5-0.8)	(0.6-1.0)	(0.5-0.9)	(0.7-1.0)	(0.5-1.0)	(0.7-1.5)	(0.3-0.9)
Desired to ha									•		
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	1.9	1.7	2.1	1.5	1.7	1.9	1.2	1.7	1.2	0.9	1.1
	(1.4-2.7)	(1.2-2.4)	(1.4-2.9)	(1.1-2.2)	(1.2-2.6)	(1.3-2.7)	(0.8-17)	(1.2-2.4)	(0.7-1.8)	(0.5-1.7)	(0.5-2.3)
Mass media	exposure										
No	Ref.	Ref.		Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	2.7	2.3	2.3	2.3	2.5	1.8	2.5	1.5	2.0	1.2	2.0
	(2.1-3.5)	(1.8-2.9)	(1.8-2.9)	(1.7-3.0)	(1.9-3.3)	(1.4-2.3)	(1.9-3.4)	(1.2-2.0)	(1.4-2.8)	(0.8-1.9)	(1.1-3.7)

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Maternal & sociodemogr- aphic	Highest $(\geq 4 ANC)$ visits,	Higher (2-3 ANC visits,	High $(\geq 4 ANC)$ visits,	Mod- high (2-3 ANC visits, health	Slightly high (≥4 ANC	$\begin{array}{c c} \textbf{Mod-low} \\ (\geq 4 \ ANC \\ visits, \ No \end{array}$	Mod-lower (2-3 ANC visits, no	Very low (2-3 ANC visits, No	Strategic- lowest (1 ANC visit,	`Unstrategic'- lowest (1 ANC visit, 1 st	2 nd lowes (No ANC visit,
characteristi-	health	Health	health	facility birth,	visits, No	health	health	health	<i>1st contact in</i>	contact in 1^{st}	health
cs	facility	facility	facility	no PNC).	health	facility	facility birth,	facility	3^{rd} trimester,	or 2^{nd}	facility
0	birth &	delivery,	birth, no	<i>no i ive)</i> .	facility birth,	birth, no	PNC).	birth, no	^a some facility	trimester,	birth,
	PNC).	PNC)	PNC).		PNC).	PNC).	1110).	PNC).	births and	^c some facility	^e some
	11(0).	11(0)	11(0).		11(0).	11(0).		1110).	^b some PNC)	births and	PNC).
										^d some PNC)	
		1		Ver	sus lowest care-s	seeking level,	,95%CI		1		•
Told about p	oregnancy	complicatio	ns (only for	r Kenya)							
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref		-
Yes*	2.5	1.4	1.9	1.1	1.4	0.7	1.0	0.6	0.5		-
	(1.6-4.1)	(0.9-2.4)	(1.2-3.1)	(0.7-1.8)	(0.9-2.2)	(0.4-1.2)	(0.6-1.6)	(0.7-1.0)	(0.3-0.9)		
Who ultimate	ly makes ca	are-seeking d	ecisions								
Respondent alone(woman)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Both partner	0.6	0.6	0.6	0.5	0.5	0.6	0.5	0.7	0.5	0.7	0.4
/respondent	(0.4-0.8)	(0.6-0.8)	(0.5-0.9)	(0.4-0.7)	(0.3-0.7)	(0.4-0.8)	(0.4-0.7)	(0.5-0.9)	(0.4-0.8)	(0.4-1.3)	(0.2-0.8)
Husband	0.5	0.5	0.7	0.5	0.5	0.5	0.7	0.6	0.7	0.6	0.6
(partner) alone	(0.4-0.7)	(0.4-0.7)	(0.5-0.9)	(0.3-0.7)	(0.3-0.7)	(0.3-0.7)	(0.5-0.9)	(0.5-0.9)	(0.5-1.1)	(0.3-1.1)	(0.3-1.2)
Maternal ag	e										
15-24	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
25-34	1.1	0.9	0.8	0.7	1.1	0.7	1.1	0.8	0.6	0.6	0.5
	(0.8-1.5)	(0.6-1.3)	(0.6-1.1)	(0.5-1.1)	(0.7-1.6)	(0.5-1.0)	(0.8-1.7)	(0.5-1.1)	(0.4-1.1)	(0.4-1.2)	(0.2-1.1)
35-49	1.1	0.9	0.9	0.7	1.2	0.7	1.2	0.9	0.8	0.8	0.5
	(0.8-1.7)	(0.6-1.4)	(0.6-1.3)	(0.4-1.1)	(0.7-2.0)	(0.4-1.0)	(0.7-2.0)	(0.6-1.4)	(0.5-1.6)	(0.4-1.7)	(0.2-1.4)
Place of reside		-	1	1	1		-		1	1	1
Urban	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Rural	0.5	0.5	0.4	0.6	0.5	0.9	0.5	0.9	0.6	0.4	0.5
	(0.4-0.8)	(0.4-0.8)	(0.3-0.6)	(0.4-0.8)	(0.3-0.8)	(0.6-1.4)	(0.3-0.7)	(0.6-1.3)	(0.4-1.0)	(0.2-0.7)	(0.3-1.1)
Marital status	-		1 -		-		1 -	-	1 -		-
Single	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Married	3.6	3.2	3.8	3.8	1.1	4.4	1.0	3.9	1.4	2.5	1.6
	(2.4-5.4)	(2.9-5.0)	(2.4-5.9)	(2.3-6.2)	(0.7-1.7)	(2.7-7.1)	(0.6-1.5)	(1.9-4.6)	(0.8-2.6)	(1.0-6.1)	(0.6-4.2)

Maternal & sociodemogr- aphic characteristi- cs	Highest ($\geq 4 ANC$ visits, health facility birth & PNC).	Higher (2-3 ANC visits, Health facility delivery, PNC)	High $(\geq 4 ANC$ 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, 1 st contact in 3 rd trimester, ^a some facility births and ^b some PNC)	'Unstrategic'- lowest (1 ANC visit, 1 st contact in 1 st or 2 nd trimester, ^c some facility births and ^d some PNC)	2nd lowes (No ANC visit, health facility birth, ^e some PNC).
Wealth status											
D	D.C.	D.C.		1	sus <i>lowest</i> care-s	<u> </u>		D.C	D.C.	D.C.	D (
Poor	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Middle	1.9	2.1	2.3	2.0	1.4	2.0	1.4	1.6	1.8	2.9	2.0
D' 1	(1.3-2.9)	(1.4-3.2)	(1.5-3.5)	(1.3-3.1)	(0.9-2.2)	(1.3-3.1)	(0.9-2.2)	(1.1-2.5)	(1.1-3.0)	(1.5-5.4)	(1.0-4.5)
Rich	1.9	1.7	1.7	1.7	0.6	1.2	0.3	0.8	0.9	1.6	2.2
Parity	(1.2-2.8)	(1.1-2.6)	(1.1-2.6)	(1.1-2.6)	(0.4-0.9)	(0.8-1.8)	(0.2-0.5)	(0.6-1.3)	(0.5-1.6)	(0.8-3.1)	(1.0-4.5)
Primiparous	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Para 2-3	0.7	0.9	0.8	0.9	1.3	1.4	1.7	1.6	0.9	1.0	0.8
Pala 2-3	(0.5-1.1)	(0.9) (0.6-1.3)	(0.5-1.3)	(0.5-1.4)	(0.8-2.2)	(0.9-2.2)	(1.0-2.8)	(1.0-2.5)	(0.5-1.7)	(0.5-2.1)	(0.3-1.7)
Para 4+	0.5	0.7	0.7	0.8	0.9	1.8	1.3	1.9	1.3	0.9(0.4-2.1)	1.0
1 ala 4 1	(0.3-0.9)	(0.4-1.2)	(0.4-1.2)	(0.5-1.4)	(0.5-1.6)	(1.1-2.9)	(0.7-2,2)	(1.2-3.3)	(0.6-2.6)	0.9(0.4-2.1)	(0.4-2.8)
Some – a propo				^b 25%, ^c 50%, ^d 19				d - Moderate			(0.4 2.0)
some a propo		nui specifie eui	<i>czory. 5770</i> ,	2370, 3070, 17	/0, 57/0. 1	<i>just, 2</i> set			iy .		

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 2^{nd} 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	Ref.	Ref.
$(\geq 4$ ANC visits, health facility birth & yes	ICI.	NCI.
PNC).		
Higher	1.5(1.0-2.4)	1.3(0.7-2.2)
(2-3 ANC visits, Health facility birth & yes PNC).		
High	1.5(1.0-2.2)	1.5(1.0-2.3)
$(\geq 4 ANC$ visits Health facility birth & no PNC).		
Moderately high	2.4(1.6-3.7)	2.2(1.4-3.4)
(2-3 ANC visits, health facility birth & no PNC).		
Slightly high/moderately lower	0.4(0.1-1.2)	0.5(0.2-1.3)
$(\geq 2 ANC visit, no health facility birth & yes PNC).$		
Very low/moderately low	1.6(1.1-2.3)	1.6(1.1-2.4)
$(\geq 2ANC \text{ visit, no health facility birth } \&$ no PNC).		
Strategic/`unstrategic' lowest (3 rd	1.7(0.8-3.7)	1.9(0.7-5.3)
lowest), (1 ANC visit, some (39% in this category) facility births and some (25% in this category) PNC		
2 nd lowest	5.8(2.9-11.6)	3.8(1.7-8.6)
(No ANC visit, facility births and some	5.0(2.7-11.0)	5.0(1.7-0.0)
(39% in this category) PNC.		/
Lowest	4.0(2.3-6.9)	3.8(2.1-6.8)
(No ANC visit, no facility births and some (13% in this category) PNC.		

Figure 5 shows that 22% neonatal deaths were attributable to inadequate maternal careseeking 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.

.vient uurters (75). uya and Uganda e .VC 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 careseeking 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 careseeking,[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

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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 evidencebased standard framework for ranking or classifying mothers on the basis of their care-

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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.

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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.

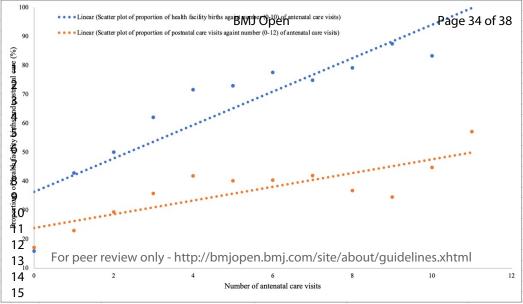
Figure 2. A scatter plot showing correlation between number of antenatal care visits and proportions of facility births and postnatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

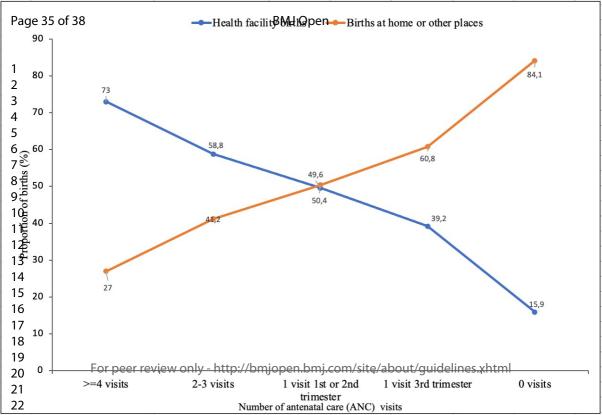
Figure 3. Proportion of hospital and home births by number of antenatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

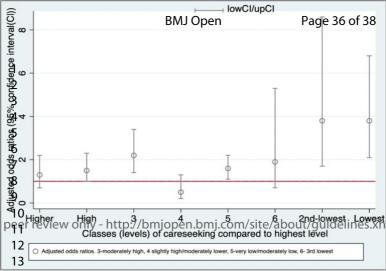
Figure 4: A forest plot showing adjusted odds ratios between continued care-seeking behavioral classes/levels and neonatal mortality, using Kenya and Uganda, 2014-2016 demographic and health survey data.

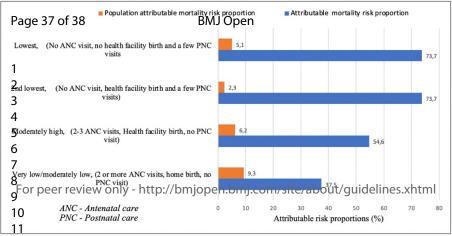
Figure 5: Attributable and population attributable neonatal mortality risk proportion for lower categories of care-seeking in Kenya and Uganda, using demographic and health survey 2014-2016 data.











Supplementary file 1.

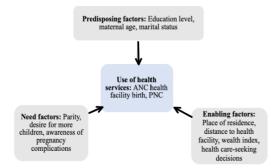


Figure showing behavioral model of utilization of health care services, modified from Andersen and Newman model.

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Supplementary file 2.

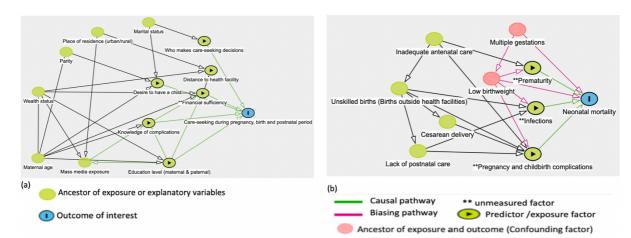


Figure 1: Directed acyclic graphs showing the predictor-outcome relationship for both care-seeking and neonatal survival in Kenya and Uganda, (Developed from <u>www.dagitty.net</u>, using DAGitty version 3.0.)

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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 crosssectional, 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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4 5	2	postnatal and associated neonatal survival outcomes in Kenya and Uganda: analysis of
6	3	cross-sectional, demographic and health survey data.
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3 4	1	Abstract
5 6	2	Objectives: To examine how maternal and sociodemographic factors determine continued
7	3	maternal care-seeking behaviour from pregnancy to postnatal period in Kenya and Uganda
8 9	4	and to estimate associated neonatal survival outcomes.
10 11	5	Method: Using population-based cross-sectional survey data for Uganda and Kenya, 2014-
12	6	2016, we employed multinomial regression to examine how maternal and sociodemographic
13 14	7	factors predict continuity of care-seeking. Associated neonatal survival outcomes were
15 16	8	assessed using binary logistic regression.
17	9	Results: Overall, 57% of mothers had 4 or more antenatal care contacts, of which 73% and
18 19	10	41% had facility births and postnatal care, respectively. Maternal and paternal education
20 21	11	versus no education were associated with continued care-seeking in majority of care-seeking
22 23	12	classes; relative risk ratios, RRR ranged from 2.1–8.0 (95% confidence intervals [95% CI]
24	13	1.1–16.3). Similarly, exposure to mass media was generally associated with continued care-
25 26	14	seeking, RRRs ranged from 1.8–3.2 (95% CI 1.2–5.4). However, care-seeking tendency
27 28	15	reduced if a husband made major maternal care-seeking decisions. Transportation problems
29	16	and living in rural versus urban were largely associated with lower continued care utilization,
30 31	17	RRR ranged from 0.4 – 0.7 (95% CI 0.3–0.9). The two <i>lowest</i> care-seeking categories with
32 33	18	no ANC and no PNC indicated the highest odds for neonatal mortality, aOR 4.2 (95% CIrange
34 35	19	1.6-10.9). 23% neonatal deaths were attributable to inadequate maternal care attendance.
36	20	Conclusion: Strategies such as mobile health (mHealth) specifically for promoting continued
37 38	21	maternal care utilization up to postnatal could be integrated in the existing structures.
39 40	22	Another strategy would be to develop and employ a brief standard questionnaire to determine
41	23	a mother's continued care-seeking level during the first ANC visit and use the information to
42 43	24	close the care-seeking gaps where most needed. Strengthening the community health
44 45	25	workers system to be integral part of promoting continued maternal care-seeking could
46 47	26	enhance care-seeking as a stand-alone strategy or as a component of both previously
48	27	suggested strategies above.
49 50	28	Keywords: Continued care-seeking behaviour, neonatal mortality.
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1 2		
2 3 4	1	Strengths and limitations of this study
5	2	• The nationally representativeness of the data and the large sample size of the study
6 7	3	allowed for valid stratified analysis with implications for national policy developments to
8 9	4	improve neonatal survival outcomes for countries in sub-Saharan Africa region.
10 11	5	
12	6	• Recall bias may not be completely eliminated from the study since the data was collected
13 14	7	retrospectively through interviews.
15 16	8	
17 18	9	• However, by selecting the most recent births and owing to the fact that childbirth is a
19	10	special event not easily forgettable, the study findings reflect the reality with considerable
20 21	11	validity.
22 23	12	
24	13	• The study was based on maternal attendance to care and not the actual obstetric services
25 26	14	received thus aspects related to lack of drugs, inadequate facilities or quality of care were
27 28	15	not captured in our study.
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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.

2829 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

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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].

14 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].

24 Study variables

5 25 **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

1 least/no amount of care were categorized as *lowest* class. The intermediate categories were

2 classified on the basis of optimal and perceived descending-level of care-seeking behavior as

3 higher, high, moderately high, slightly high, moderately low, moderately lower, very low, 7th

4 lowest, 6th lowest, 5th lowest, 4th lowest, 3rd lowest, 2nd lowest and lowest, as shown in Table 1

5 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 facili				
PNC - Yes	Highest	Higher	7 th lowest	_
PNC - No	High	Moderate high	6 th lowest	3 rd lowest
Birth outside	e of health facili	ty		
PNC - Yes	Slightly high	Moderately lower	5 th lowest	2 nd lowest
PNC - No	Moderately	Very low	4 th lowest	Lowest
	low	-		
ANC – Antenato	al care, PNC – Posti	natal care, 1 st – first, 2 nd	– 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.

21 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

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1 35–49 years years old while *place of residence* remained as *rural* and *urban* [46]. Marital 2 status was dichotomized into single or married [47]. A mother having a problem with longer 3 distance/transportation to nearest health facility was classified as 'yes' if it was a problem 4 and `no' if it was not [48]. Desire to have a newborn child, whether or not mother was told 5 about pregnancy complications [49] and having exposure to mass media [50] were all 6 categorized as 'yes' and 'no'. The variable who ultimately makes maternal care-seeking 7 decisions was categorized as respondent (woman) alone, husband alone or joint decision [51]. 8 Education was categorized as no education, primary education and secondary or higher [52]. 9 *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 10 11 (poor/poorest), middle and rich(rich/richest) [52, 53]. The wealth status in DHS is indexed 12 based on household cumulative living standards taking into account assets possessed, water 13 and sanitation facilities. Place of residence was classified into rural and urban [53]. 14

15 Mapping the predictor – outcome relationship using directed acyclic graphs

16 Prior to the analysis, the directed acyclic graphs (DAGs) by Textor and colleagues [54] were 17 used to map the predictors of both care-seeking behaviors and neonatal mortality on the basis 18 of existing peer-reviewed evidence and to identify any confounding bias in our models. 19 Supplementary file 2, Diagrams 1.a and b illustrate the process. For Diagram 1.b, the lower 20 levels of care-seeking are represented by a lack of a care component(s) that is/are major non-21 causal risk factor for neonatal mortality.

23 **Data analysis**

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24 We used cross-tabulations to examine the distribution of mothers across variables and 25 variable categories in the different levels of care-seeking continuum. We also investigated 26 correlations between ANC visits and proportions of health facility childbirths and PNC visits. 27 Multinomial logistic regression models examined the associations between sociodemographic and maternal factors and continued care-seeking at different care-seeking classes/categories, 28 29 with the *lowest* class as the reference group. The independent variables were mutually 30 adjusted for each other.

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32 Binary logistic regression was used to determine the odds ratios (OR) for the associations 33 between the various classes of care-seeking continuum and neonatal mortality. For plausible 34 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.

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

30 Results

Table 2 and Figure 1 indicate that over 95% of mothers had at least 1 ANC visit and about

56 32 56% had 4 or more ANC contacts in Kenya and Uganda. Of those who had 4 or more ANC

⁵⁷ 33 visits, 73% gave birth at a health facility and about 41% had newborn PNC check-up within

59 34 28 days after birth as shown in Table 2.60

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2 period, childbirth and within 28 days postnatal in Kenya and Uganda, using demographic and

	\geq 4 ANC	2-3 ANC visits,	1 ANC visit,	0 ANC visit,
	visits,	n=8744	N=775	N=1095
	n=13888			
Health facili	ty 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	e of health facil	lity		
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 – Antenato	al care, PNC – Pos	tnatal care, 1^{st} – first, 2^{na}	¹ -Second	

3 health survey 2014-2016 data, N=24502

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.

10 Table 3 shows the distribution of maternal and sociodemographic characteristics by care-11 seeking behaviour from pregnancy to postnatal period. Majority (≥ 46%) of the mothers 12 were between 25–34 years of age in all care-seeking categories. Overall, about 71% of the 13 mothers lived in a rural setting and 37 % of all women had problems with distance to the 14 nearest health facility. Roughly 30 % and 57% of those who had highest and lowest care-15 seeking tendencies respectively, indicated distance could be a hindrance to care-seeking. 16 Slightly over half of all the mothers had primary education. About 40% of highest care-17 seekers had secondary or higher education while 60% of lowest care-seekers had no formal 18 education. Similar trends were observed among their husbands/partners (education).

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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 1	nore ANG	C visits, n=	13888	2	-3 ANC vis	its, n=874	44	1 ANC visits, n=775				0 ANC visit, n=1027			
	Highest	High	Slightly	Mod-	Higher	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd	Lowes	
	(facility	(facilit	high (no	low (no	(facility	high	lower	low (no	lowest	lowest	lowest	lowest	lowest	lowest	t	
	birth &	y	facility	facility	birth,	(facility	(no	facility	(facilit	(facility	(no	(no	(facilit	(no	(no	
	PNC).	birth,	birth,	birth, no	PNC).	birth, no	facility	birth, no	y y	birth, no	facility	facility	y y	facility	facility	
	n (%)	no	PNC).	PNC).	n (%)	PNC).	birth,	PNC).	birth,	PNC)	birth,	birth, no	birth,	birth,	birth,	
		PNC).	n (%)	n (%)		n (%)	PNC).	n (%)	PNC)	n (%)	PNC)	PNC)	no	PNC)	no	
		n (%)					n (%)		n (%)		n (%)	n (%)	PNC)	n (%)	PNC)	
Variables		, í											n (%)		n (%)	
Maternal a	age (Years)															
15-24	1625	1680	213	815	832	1001	159	778	51	77	20	123	43	36	189	
	(32.8)	(32.4)	(28.3)	(27.2)	(35.3)	(36.0)	(25.2)	(26.2)	(44.4)	(36.2)	(31.8)	(32.0)	(40.6)	(29.7)	(23.6)	
25-34	2406	2513	315	1410	1064	1240	303	1385	35	91	17	160	41	52	360	
	(48.5)	(48.5)	(46.6)	(47.1)	(45.2)	(44.6)	(47.9)	(46.6)	(30.4)	(42.7)	(27.0)	(41.7)	(38.7)	(43.0)	(45.0)	
35-49	930	986	189	771	459	541	170	812	29	45	26	101	22	33	251	
	(18.7)	(19.1)	(25.1)	(25.7)	(19.5)	(19.4)	(26.9)	(27.3)	(25.2)	(21.1)	(41.2)	(26.3)	(20.7)	(27.3)	(31.4)	
Place of re																
Urban	1669	2096	164	483	677	956	122	409	30	79	14	52	33	18	85	
	(33.6)	(40.5)	(21.8)	(16.1)	(28.8)	(34.4)	(19.3)	(13.8)	(26.1)	(37.1)	(22.2)	(13.5)	(31.1)	(14.9)	(10.6)	
Rural	3292	3083	588	2513	1678	1826	510	2566	85	134	49	332	73	103	715	
	(66.4)	(59.5)	(78.2)	(83.9)	(71.3)	(65.6)	(80.7)	(86.2)	(73.9)	(62.9)	(77.8)	(86.5)	(68.9)	(85.1)	(89.4)	
Distance to		1				1	1	1		1	1	1	I	1		
No	3490	1561	472	876	1580	810	379	862	74	60	36	97	34	62	148	
	(70.3)	(66.5)	(62.8)	(52.3)	(67.1)	(62.9)	(60.1)	(50.5)	(64.4)	(63.2)	(57.1)	(47.1)	(68)	(51.2)	(42.8)	
Yes	1471	785	280	798	775	477	252	844	41	35	27	109	16	59	198	
	(29.7)	(33.5)	(37.2)	(47.7)	(32.9)	(37.1)	(39.9)	(49.5)	(35.6)	(36.8)	(42.9)	(52.9)	(32.0)	(48.8)	(57.2)	
Maternal e		1		1	1	1	1	1							L	
No	435	389	167	811	241	271	140	726	15	42	18	139	20	63	486	
education	(8.8)	(7.5)	(22.2)	(27.1)	(10.2)	(9.8)	(22.2)	(24.4)	(13.0)	(19.7)	(28.6)	(36.2)	(18.9)	(52.0)	(60.8)	
Primary	2535	2721	486	1789	1369	1645	399	1960	73	124	37	218	57	52	280	
	(51.1)	(52.5)	(64.6)	(59.7)	(58.2)	(59.1)	(63.1)	(65.9)	(63.5)	(58.2)	(58.7)	(56.8)	(53.8)	(43.0)	(35.0)	
Mod- Mode	erately.															

	4 or 1	more AN	<u>C visits, n=</u>	13888	2	2-3 ANC visits, n=8744				1 ANC vis		0 ANC visit, n=1027			
	Highest	High	Slightly	Mod-	Higher	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd	Lowe
	(facility	(facilit	high (no	low (no	(facility	high	lower	low (no	lowest	lowest	lowest	lowest	lowest	lowest	t
	birth &	y	facility	facility	birth,	(facility	(no	facility	(facilit	(facility	(no	(no	(facilit	(no	(no
	PNC).	birth,	birth,	birth, no	PNC).	birth, no	facility	birth, no	y y	birth, no	facility	facility	v	facility	facilii
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	<i>n</i> (70)	PNC).	n(%)	n (%)		n(%)	PNC).	n(%)	PNC)	n(%)	PNC)	PNC)	no	PNC)	no
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Variables		<i>n</i> (70)							<i>n</i> (70)			<i>n</i> (70)	n(%)		n(%)
Secondar	1991	2069	99	396	745	866	93	289	27	47	8	27	29	6	34
y and	(40.1)	(40.0)	(13.2)	(13.2)	(31.6)	(31.1)	(14.7)	(9.7)	(23.5)	(22.1)	(12.7)	(7.0)	(27.3)	(5.0)	(4.3)
higher	(40.1)	(40.0)	(13.2)	(13.2)	(31.0)	(31.1)	(14.7)	()./)	(23.3)	(22.1)	(12.7)	(7.0)	(27.5)	(5.0)	(4.5)
Partner/hu	ah an d'a du														
No	255	128	118	276	142	68	98	259	7	17	13	39	4	52	173
					$\begin{vmatrix} 142\\(7.4) \end{vmatrix}$		(16.8)				(23.2)		4 (13.8)		
education	(6.1)	(6.5)	(16.9)	(19.1)		(6.5)	· · ·	(17.5)	(8.4)	(23.0)		(23.8)		(49.5)	(55.0)
Primary	1860	991	401	815	1011	590	348	938	46	39	32	96	19	43	109
<u> </u>	(44.6)	(50.3)	(57.5)	(56.5)	(52.4)	(56.2)	(59.8)	(63.5)	(55.4)	(52.7)	(57.1)	(58.5)	(65.5)	(41.0)	(35.3)
Secondar	2059	851	179	352	777	392	136	280	30	18	11	29	6	10	27
y &	(49.3)	(43.2)	(25.6)	(24.4)	(40.2)	(37.3)	(23.4)	(19.0)	(36.1)	(24.3)	(19.6)	(17.7)	(20.7)	(9.5)	(8.7)
higher															
Knowledge										1					
No	537	319	348	286	341	250	349	351	29	23	44	63	-	-	-
	(32.8)	(39.1)	(47.4)	(63.4)	(45.6)	(53.7)	(55.6)	(66.9)	(64.4)	(50.0)	(69.8)	(75.9)			
Yes	1099	496	386	165	407	216	279	174	16	23	19	20	-	-	-
	(67.2)	(60.9)	(52.6)	(36.6)	(54.4)	(46.3)	(44.4)	(33.1)	(35.6)	(50.0)	(30.2)	(24.1)			
Desire to h		/						_							
No	142	215	97	206	249	153	120	257	24	22	18	40	7	29	48
	(8.7)	(9.2)	(12.9)	(12.3)	(10.6)	(11.9)	(19.0)	(15.1)	(20.9)	(23.2)	(28.6)	(19.4)	(14.0)	(24.0)	(13.9)
Yes	1496	2132	654	1469	2106	1133	512	1449	91	73	45	166	43	92	298
	(91.3)	(90.8)	(87.1)	(87.7)	(89.4)	(80.1)	(81.0)	(84.9)	(79.1)	(76.8)	(71.4)	(80.6)	(86.0)	(76.0)	(86.1)
Who ultim	ately make	es care-se	eking decis	ions											
Respond-	1337	548	229	461	600	343	172	416	28	14	16	49	10	18	61
ent alone	(32.7)	(28.6)	(36.6)	(32.2)	(31.9)	(33.0)	(33.0)	(28.9)	(34.2)	(19.4)	(36.4)	(30.2)	(35.7)	(22.2)	(20.7)

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		Highest	High	Slightly	Mod-	Higher	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd	Lowes
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ParityParityPrimiparo129313889632455571568295325310532813us(26.1)(26.8)(12.8)(10.8)(23.6)(25.7)(10.8)(9.9)(27.8)(24.9)(15.9)(13.8)(26.4)(10.7)Para 2-31877211328798885510612199062872161083336(37.8)(40.8)(38.2)(33.0)(36.3)(38.1)(34.7)(30.5)(24.4)(33.8)(25.4)(28.1)(31.1)(29.8)Para 4+179116783691684945100634517745588372234572Wealth statusPoor17851739497195399411814462108521065028543103Middle8541031132556457565127498244420601015Middle8541031132556457565127498244420601015Middle85988012348790410365936939633639103Middle85988012348790410365936939633639 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>(33.7)</td></t<>																(33.7)
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$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$																(85.5)
Rich 2322 2409 123 487 904 1036 59 369 39 63 36 39 10 3 (46.8)(46.5)(16.4)(16.3) (38.4) (37.2) (9.3) (12.4) (33.9) (29.6) (34.9) $(10.29$ (15.9) (2.5) Marital statusSingle 859 880 123 435 464 403 109 458 33 55 19 90 38 39 (17.3) (17.0) (16.4) (14.5) (19.7) (20.6) (17.3) (15.4) (28.7) (25.8) (30.2) (23.4) (35.9) (32.2) Married 4102 4299 629 2561 1891 1558 523 2517 82 158 444 294 68 82 (82.7) (83.0) (83.6) (85.5) (80.3) (79.5) (82.7) (84.6) (72.3) (74.2) (69.8) (76.6) (64.1) (67.8)	Middle			132				127						10		51
(46.8) (46.5) (16.4) (16.3) (38.4) (37.2) (9.3) (12.4) (33.9) (29.6) (34.9) (10.29 (15.9) (2.5) Marital status Single 859 880 123 435 464 403 109 458 33 55 19 90 38 39 (17.3) (17.0) (16.4) (14.5) (19.7) (20.6) (17.3) (15.4) (28.7) (25.8) (30.2) (23.4) (35.9) (32.2) Married 4102 4299 629 2561 1891 1558 523 2517 82 158 44 294 68 82 (82.7) (83.0) (83.6) (85.5) (80.3) (79.5) (82.7) (84.6) (72.3) (74.2) (69.8) (76.6) (64.1) (67.8)		(17.2)	(19.9)	(17.6)	(18.5)	(19.4)	(20.3)	(20.1)	(16.7)	(20.9)	(20.7)	(18.9)	(15.6)	(15.9)	(12.4)	(6.4)
Marital statusSingle 859 880 123 435 464 403 109 458 33 55 19 90 38 39 (17.3) (17.0) (16.4) (14.5) (19.7) (20.6) (17.3) (15.4) (28.7) (25.8) (30.2) (23.4) (35.9) (32.2) Married 4102 4299 629 2561 1891 1558 523 2517 82 158 44 294 68 82 (82.7) (83.0) (83.6) (85.5) (80.3) (79.5) (82.7) (84.6) (72.3) (74.2) (69.8) (76.6) (64.1) (67.8)	Rich	2322	2409	123	487	904	1036	59	369	39	63	36	39	10	3	65
Single 859 880 123 435 464 403 109 458 33 55 19 90 38 39 (17.3) (17.0) (16.4) (14.5) (19.7) (20.6) (17.3) (15.4) (28.7) (25.8) (30.2) (23.4) (35.9) (32.2) Married 4102 4299 629 2561 1891 1558 523 2517 82 158 44 294 68 82 (82.7) (83.0) (83.6) (85.5) (80.3) (79.5) (82.7) (84.6) (72.3) (74.2) (69.8) (76.6) (64.1) (67.8)		(46.8)	(46.5)	(16.4)	(16.3)	(38.4)	(37.2)	(9.3)	(12.4)	(33.9)	(29.6)	(34.9)	(10.29	(15.9)	(2.5)	(8.1)
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(82.7) (83.0) (83.6) (85.5) (80.3) (79.5) (82.7) (84.6) (72.3) (74.2) (69.8) (76.6) (64.1) (67.8)	C	(17.3)	(17.0)	(16.4)	(14.5)	(19.7)	(20.6)	(17.3)	(15.4)	(28.7)	(25.8)	(30.2)	(23.4)	(35.9)	(32.2)	(15.4)
	Married			629	2561		1558		2517		158		294	68	82	677
		(82.7)	(83.0)	(83.6)	(85.5)	(80.3)	(79.5)	(82.7)	(84.6)	(72.3)	(74.2)	(69.8)	(76.6)	(64.1)	(67.8)	(84.6)
Mass media exposure	Mass medi	a exposure	e													

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

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

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2		
3 4	1	random classes, the rest were not statistically significant. Additionally, being rich indicated
5	2	almost no significant association with care-seeking. Figure 4 summarizes in a forest plot,
6 7	3	selected (extremes) results from table 4.
8 9	4	
10	5	
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41	31	
42	32	
43	33	
44 45	34	
45 46	35	
46 47	36	
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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.

	Highest	Higher	High	Mod-	Slightly	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd
	(≥4	(2-3	$(\geq 4 ANC)$	high	high	low (≥4	lower	low (2-3	lowest	lowest	lowest	lowest	lowest	lowest
	ANC	ANC	visits,	(2-3	(≥4	ANC	(2-3	ANC	(1 ANC	(1 ANC	(1 ANC	(1 ANC	(No	(No
	visits,	visits,	facility	ANC	ANC	visits, no	ANC	visits,	visit,	visit,	visit, no	visit, no	ANC	ANC
	facility	facility	birth,	visits,	visits,	facility	visits,	no	facility	facility	facility	facility	visit,	visits,
Variables	birth &	birth,	no	facility	no	birth, no	no	facility	birth,	birth, no	birth,	birth,	facility	no
	PNC).	PNC).	PNC).	birth, no	facility	PNC).	facility	birth, no	PNC)	PNC)	PNC)	no	birth,	facility
	Í	, í	Í	PNC).	birth,		birth,	PNC).	,	,		PNC)	no PNC)	birth,
				, í	PNC).		PNC).	, í				/	´	PNC)
	1	1	Versus lo	west (no ANG	C, no facility	v birth, no PN	VC) care-see	king level, 9	5% Confiden	ce Interval (9	5%CI)	1		
Maternal ed	lucation lev	vel					·							
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
education						6								
Primary	3.2	3.2	3.4	2.7	2.1	2.3	2.1	2.8	2.6	1.5	1.7	1.7	2.6	0.9
5	(2.3-4.4)	(2.2,4.6)	(2.4-4.9)	(1.9-4.0)	(1.5-3.1)	(1.6-3.2)	(1.5-3.2)	(2.0-4.0)	(1.2-5.7)	(0.7-3.0)	(0.8-3.8)	(1.0-2.8)	(0.8-9.0)	(0.5-1.0
Secondary	8.0	6.9	6.9	4.9	2.5	3.1	3.9	2.9	3.4	1.7	2.1	1.5	4.3	0.6
& higher	(4.0- 16.3)	(3.3-14.1)	(3.4,14.2)	(2.3-10.2)	(1.2-5.4)	(1.5-6.4)	(1.8-8.4)	(1.7-4.9)	(1.1-10.7)	(0.5-5.4)	(0.6-8.2)	(0.5-4.1)	(0.8,23.0)	(0.1-2.9
Partner/hus	band educ	ation level	l											
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
education														
Primary	3.3	3.4	3.6	4.7	2.6	2.1	2.7	2.7	3.4	1.9	1.9	2.5	_	1.2
5	(2.4-4.7)	(2.4-5.0)	(2.5-5.3)	(3.1-7.1)	(1.8-3.9)	(1.5-3.1)	(1.8-4.0)	(1.9-3.8)	(1.3-8.7)	(0.9-4.1)	(0.8-4.4)	(1.5-4.4)		(0.7-2.2
Secondary	6.4	5.5	6.2	7.2	3.7	3.0	3.4	2.9	6.0	2.3	2.1	3.3	-	1.2
& higher	(3.8- 10.6)	(3.2-9.2)	(3.7-10.6)	(4.1-12.7)	(2.1-6.5)	(1.8-5.1)	(1.9-6.0)	(1.7-4.9)	(2.1-17.4)	(0.9-6.1)	(0.7-6.3)	(1.5-6.9)		(0.5-3.0
Distance to	nearest hea	alth facilit	y is a big pi	roblem										
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	0.6	0.6	0.7	0.7	0.6	0.8	0.7	0.8	0.7	0.6	0.7	1.1	0.6	0.8
	(0.5-0.8)	(0.5-0.8)	(0.5-0.9)	(0.5-0.9)	(0.5-0.8)	(0.6-1.0)	(0.5-0.9)	(0.6-1.1)	(0.4-1.2)	(0.3-1.0)	(0.4-1.3)	(0.7-1.6	(0.3-1.4)	(0.5-1.)
Desire to ha		I		I	I	I	l	l	I		I		l	I
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

	Highest	Higher	High	Mod-	Slightly	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd
	(≥4	(2-3	$(\geq 4 ANC)$	high	high	low (≥4	lower	low (2-3	lowest	lowest	lowest	lowest	lowest	lowes
	ANC	ANC	visits,	(2-3	(≥4	ANC	(2-3	ANC	(1 ANC	(1 ANC	(1 ANC	(1 ANC	(No	(No
	visits,	visits,	facility	ANC	ANC	visits, no	ANC	visits,	visit,	visit,	visit, no	visit, no	ANC	ANC
	facility	facility	birth,	visits,	visits,	facility	visits,	no	facility	facility	facility	facility	visit,	visits,
Variables	birth &	birth,	no	facility	no	birth, no	no	facility	birth,	birth, no	birth,	birth,	facility	no
	PNC).	PNC).	PNC).	birth, no	facility	PNC).	facility	birth, no	PNC)	PNC)	PNC)	no	birth,	facilii
			1	PNC).	birth,	1	birth,	PNC).				PNC)	no PNC)	
		· · · · · · · · · · · · · · · · · · ·			PNC).		PNC).	· · · · · · · · · · · · · · · · · · ·						PNC)
			1							nce Interval (9				
Yes	1.5	1.3	1.6	1.2	1.3	1.4	0.9	1.3	0.7	0.8	0.5	1.0	0.5	0.4
	(1.0-2.2)	(0.9-2.0)	(1.1-2.4)	(0.8-1.8)	(0.8-2.0)	(1.0-2.2)	(0.5-1.3)	(0.9-2.0)	(0.3-1.4)	(0.4-1.7)	(0.2-1.2)	(0.6-1.8)	(0.2-1.7)	(0.2-0
Mass media														1 - 0
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	3.2	2.7	2.7	2.7	3.0	2.1	3.0	1.8	2.9	1.6	3.2	1.5	2.0	2.0
T 11 1 ((2.4-4.2)	(2.0-3.6)		(2.0-3.7)	(2.2-4.1)	(1.6-2.8)	(2.2-4.2)	(1.4-2.4)	(1.6-5.4)	(0.9-3.0)	(1.6-6.3)	(1.0-2.4)	(0.8-4.8)	(1.2-3
Told about	1 0 0	<u></u>		<u>```</u>	v /		0		1					
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	-	-	_		_	-	
Yes	2.6	1.7	2.1	1.1	2.0	1.2	1.5	-	-	-	-	-	-	-
XX71 ltime	(2.0-3.2)	(1.3-2.2)		(1.0-1.7)	(1.6-2.5)	(0.9-1.6)	(1.2-1.9)	<u> </u>						
Who ultima		1			Def	Def	Def	Def	Def	Def	Def	Def	Def	Def
Respond- ent alone	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Both	0.5	0.6	0.6	0.5	0.5	0.5	0.5	0.7	0.5	1.3	0.4	0.5	0.4	0.9
	(0.4-0.8)	(0.4-0.8)		(0.4-0.8)	(0.3-0.7)	(0.4-0.8)	(0.3-0.7)	(0.5-0.9)	(0.3-0.9)	(0.6-2.5)	(0.2-0.9)	(0.3-0.9)	(0.1-1.0)	(0.5-1
Husband	0.5	0.5	0.7	0.5	0.5	0.5	0.7	0.7	0.5	1.1	0.6	0.7	0.7	1.1
alone	(0.4-0.7)	(0.4-0.7)	(0.5-0.9)	(0.3-0.7)	(0.3-0.7)	(0.3-0.7)	(0.4-1.0)	(0.5-0.9)	(0.3-1.0)	(0.5-2.5)	(0.3-1.4)	(0.4-1.2)	(0.3-1.8)	(0.6-2
Maternal ag	0 \							1						
15-24	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
25-34	0.9	0.7	0.6	0.6	0.9	0.6	0.9	0.6	0.4	0.8	0.4	0.5	0.5	0.5
	(0.6-1.3)	(0.5-1.1)	(0.4-1.0)	(0.4-0.9)	(0.5-1.3)	(0.4-0.9)	(0.6-1.5)	(0.4-1.0)	(0.2-0.8)	(0.3-1.7)	(0.2-1.2)	(0.3-0.9)	(0.2-1.3)	(0.1-1
35-49	0.8	0.6	0.6	0.5	0.9	0.5	0.8	0.6	0.4	0.9	$\begin{bmatrix} 0.8 \\ (0.2, 2, 2) \end{bmatrix}$	0.6	0.3	0.3
	0.5-1.3	(0.4-1.1)	(0.4-1.0)	(0.3-0.8)	(0.5-1.5)	(0.3-0.8)	(0.5-1.5)	(0.4-1.1)	(0.1-0.9)	(0.3-2.4)	(0.3-2.3)	(0.3-1.2)	(0.1-1.4)	(0.1-0
Place of resi	idence													

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	Highest	Higher	High	Mod-	Slightly	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd
	(≥4	(2-3	$(\geq 4 ANC)$	high	high	low (≥4	lower	low (2-3	lowest	lowest	lowest	lowest	lowest	lowest
	ANC	ANC	visits,	(2-3	(≥4	ANC	(2-3	ANC	(1 ANC	(1 ANC	(1 ANC	(1 ANC	(No	(No
	visits,	visits,	facility	ANC	ANC	visits, no	ANC	visits,	visit,	visit,	visit, no	visit, no	ANC	ANC
	facility	facility	birth,	visits,	visits,	facility	visits.	no	facility	facility	facility	facility	visit,	visits,
Variables	birth &	birth,	no	facility	no	birth, no	no	facility	birth,	birth, no	birth,	birth,	facility	no
	PNC).	PNC).	PNC).	birth, no	facility	PNC).	facility	birth, no	PNC)	PNC)	PNC)	no	birth,	facili
	11(0).	1110).	1110).	PNC).	birth,	11(0).	birth.	PNC).	1110)	1110)		PNC)	no PNC)	birth,
				1100).	PNC).		PNC).	1110).				1100)		$ PNC \rangle$
			Versus la	west (no AN	/	, hirth no Pl	/	king level 9	5% Confider	nce Interval (9	5%CI)			1100
Urban	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Rural	0.4	0.4	0.3	0.4	0.4	0.7	0.4	0.7	0.3	0.2	0.4	0.6	0.5	0.4
Kulai	(0.2-0.6)	(0.2-0.6)	(0.2-0.5)	(0.3-0.7)	(0.2-0.6)	(0.4-1.1)	(0.2-0.6)	(0.4-1.1)	(0.2-0.7)	(0.2)	(0.2-1.0)	(0.3-1.2)	(0.2-1.5)	(0.2-0
Marital statu		(0.2-0.0)	(0.2-0.3)	(0.5-0.7)	(0.2-0.0)	(0.4-1.1)	(0.2-0.0)	(0.4-1.1)	(0.2-0.7)	(0.1-0.4)	(0.2-1.0)	(0.5-1.2)	(0.2-1.3)	(0.2-0
Single	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Married	1.9	1.7	2.0	2.0	0.6	2.4	0.5	1.6	1.5	1.9	0.3	1.9	1.0	0.2
Mairiea	(1.1-3.3)	(1.0-3.0)	(1.2-3.5)	(1.1-3.7)	(0.3-1.0)	(1.3-4.3)	(0.3-1.0)	(0.9-2.8)	(0.5-4.5)	(0.6-6.9)	(0.1-0.6)	(0.7-5.3)	(0.2-4.5)	(0.1-0.
Wealth statu		/_		/										
Poor	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Middle	1.8	2.0	2.2	1.9	1.3	1.9	1.3	1.5	2.7	2.6	1.4	1.8	1.7	0.9
	(1.1-3.0)	(1.2-3.3)	(1.3-3.6)	(1.1-3.2)	(0.8-2.2)	(1.2-3.2)	(0.8-2.2)	(0.9-2.6)	(1.3-5.6)	(1.2-5.9)	(0.6-3.3)	(0.9-3.4)	(0.5-5.4)	(0.4-2.
Rich	1.3	1.2	1.2	1.1	0.4	0.8	0.2	0.6	1.1	1.3	0.3	0.4	1.2	0.1
	(0.8-2.0)	(0.7-1.8)	(0.8-1.9)	(0.7-1.8)	(0.2-0.7)	(0.5-1.3)	(0.1-0.3)	(0.4-0.9)	(1.5-2.4)	(0.6-2.9)	(0.1-1.1)	(0.2-0.9)	(0.4-3.6)	(0.0-0.
Parity														
Primiparous	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Para 2-3	0.9	1.1	1.1	1.1	1.6	1.7	2.0	1.9	1.1	0.9	0.9	1.5	1.9	2.7
	(0.6-1.5)	(0.6-1.8)	(0.6-1.7)	(0.6-1.8)	(0.9-2.8)	(1.0-2.9)	(1.1-3.6)	(1.1-3.2)	(0.5.2.7)	(0.3-2.3)	(0.3-2.6)	(0.7-3.3)	(0.5-6.8)	(1.0-7
Para 4+	0.7	0.9	0.9	1.1	2.2	2.3	1.6	2.5	1.9	0.9	0.9	2.1	1.0	2.8
	(0.4-1.2)	(0.5-1.6)	(0.5-1.6)	(0.6-1.9)	(0.6-2.2)	(1.3-4.0)	(0.8-3.1)	(1.4-4.5)	(0.7-5.2)	(0.3-2.7)	(0.3-3.1)	(0.9-5.1)	(0.2-4.9)	(0.9-8

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2 3 4	1	Table 5 presents the odds ratios for the associations between continued care-seeking
5	2	categories and neonatal mortality, with the highest category as the reference class. Figure 5
6 7	3	shows a forest plot of adjusted odds ratios (aOR) for overall results in Table 5. Overall, 3rd
8 9	4	lowest and lowest categories were associated with about 4-folds odds of neonatal mortality,
10	5	aOR 4.2, (95% CI _{range} 1.6–10.9). For joint Kenya and Uganda, moderately high and very low
11 12	6	levels of care-seeking also showed significant higher odds of neonatal death; aOR ranged 1.9
13 14	7	- 2.4 for the two classes. However, the remaining two categories (4th lowest and moderately
15	8	low) did not indicate any statistically significant association with mortality. For Kenya only,
16 17	9	lowest, very low, moderately low, moderately high, and high versus highest were all
18 19	10	significantly associated with neonatal deaths and neonates in the <i>lowest</i> class were 6 times
20 21	11	likely to die. For Uganda, only very low category was significantly associated with neonatal
22	12	death, aOR 1.7 (95% CI 1.1-2.7) and <i>lowest</i> class showed higher odds but was marginally not
23 24	13	significant aOR 2.5 (95% CI 1.0-6.0). We observe that the proportion of Ugandan mothers
25 26	14	seeking continued care at highest level were more than twice (33.8%) that of Kenya (13.4%)
27	15	Table 5: Crude and adjusted odds ratios for the association between classes of care-seeking
28 29	16	behavior in continuum of care and neonatal mortality in Kenya and Uganda, using
30	17	demographic and health survey 2014-2016 data.
31		Classes of Overall Overall Proportion Kenya Proport- Uganda
32		care-seeking Crude aOR* of the total only ion of the only

Classes of care-seeking behaviour	Overall Crude odds ratio (95% CI)	Overall aOR* (95% CI)	Proportion of the total in Kenya (%)	Kenya only aOR* (95% CI)	Proport- ion of the total in Uganda (%)	Ugand only aOR* (95% CI)
	n=22538		n=12579		n=9959	
Highest (\geq 4 ANC visits, health facility birth, yes PNC).	Ref.	Ref.	(13.4)	Ref.	(33.8)	Ref.
Higher (2-3 ANC visits,	1.5	1.3	(6.1)	1.4	(16.3)	0.9
Health facility birth, yes PNC). Mis=47	(1.0-2.4)	(0.7-2.2)		(0.4-4.2)	(1000)	(0.5-1.5
High (\geq 4 ANC visits, Health	1.5	1.5	(29.8)	2.9	(15.6)	1.0
facility birth, no PNC). Mis=72	(1.0-2.2)	(1.0-2.3)		(1.4-6.0)		(0.6-1.7
Moderately high	2.4	2.2	(16.0)	3.4	(8.4)	1.6
(2-3 ANC visits, health facility	(1.6-3.7)	(1.4-3.4)	· /	(1.6-7.4)		(0.9-2.7
<i>birth and no PNC). Mis=33</i>						
Moderately low (≥4 ANC	1.3	1.3	(14.5)	2.6	(12.4)	0.8
visits, no facility birth, no PNC). Mis=44	(0.8-2.1)	(0.8-2.2)		(1.2-5.9)		(0.4-1.4
Very low (2-3 ANC visits, no	1.9	1.9	(14.7)	2.8	(12.0)	1.7
facility birth, no PNC). Mis=48	(1.3-2.8)	(1.3-2.9)	~ /	(1.3-6.2)		(1.1-2.7
4 th lowest (1 ANC visit, no	2.2	2.2	(2.1)		(1.2)	
health facility births, no PNC) Mis=2	(0.7-6.7)	(0.7-7.3)		—		_
3rd lowest (No ANC, health	7.8	4.2	(0.5)	_	(0.4)	_
facility births and no PNC). Mis=2	(3.5-17.5)	(1.6-10.9)				
Lowest (No ANC, no facility	4.5	4.2	(5.6)	6.0	(1.5)	2.5
births and no PNC.). Mis=17	(2.5-7.8)	(2.3-7.8)	· · ·	(2.6-13.6)		(1.0-6.5

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.

18 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-

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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 \geq 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

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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 vet 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 Kenva 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.

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1 Methodological considerations

2 The large sample size of the maternal and child data of the latest Kenya and Uganda DHS, 3 which are nationally representative allowed for valid stratified analysis for deeper 4 understanding of neonatal health and survival. The study is thus externally valid and 5 generalizable in other similar settings. Like many cross-sectional surveys, recall bias may 6 not be completely eliminated from the study. Nonetheless, by selecting the most recent live 7 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 8 9 care and associated neonatal survival in these countries.

11 A strength to our study was the use of directed acyclic graphs that enabled us to explicitly 12 map the predictor-outcome relationship for well guided analysis and identification of possible 13 confounders. Our study could not examine other factors such as poor attitude of nurses and 14 lack of information on health care services offered which have been found by both 15 quantitative and qualitative studies to hinder care utilization in low- and middle-income 16 countries [85, 86]. Another limitation to our study was that inadequate facilities and drugs 17 have also been associated with poor care-seeking, but our data did not capture these specific 18 aspects [87]. In addition, the cross-sectional survey design of the DHS dataset does not allow 19 collection of data on quality of care. Our study did not incorporate factors such as intimate 20 partner violence (IPV) which prevalent in many countries, IPV is known to be associated 21 with poor care-seeking behaviour [88]. Further studies can investigate this.

23 Conclusion

24 Further multi-country large-scale population-based research and systematic reviews could 25 enable development and use of a brief standard questionnaire to determine a mother's 26 continued care-seeking level during the first ANC visit and use the information to close the 27 care-seeking gaps where it's most needed. This is especially viable in LMIC with limited 28 health workforce. Similar standard questionnaires have been used previously in other areas to 29 assess care-seeking behaviour [89, 90]. The use of mobile health (mHealth) specifically for 30 promoting continued maternal care utilization up to postnatal can be integrated in the existing 31 structures. Strengthening the existing community health workers system to be integral part of 32 promoting continued maternal care-seeking could enhance care-seeking as a stand-alone 33 strategy or as a component of the above suggested strategies.

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3 4	1	Acknowledgments
5	2	Much appreciation to the DHS program and partners for availing the datasets for this study.
6 7	3	
8 9	4	Competing interest statement
10 11	5	No competing interests were reported by the authors.
12	6	
13 14	7	Ethics and dissemination
15 16	8	DHS data collection process and storage guaranteed the anonymity and confidentiality of
17	9	participants. Datasets are publicly available and permission for access and use was obtained
18 19	10	after sending a request to the DHS secretariat.
20 21	11	
22 23	12	Funding
24	13	No funds were obtained from any entity or industry by the authors of this study.
25 26	14	
27 28	15	Authors' contributions
29	16	MOA conceptualized, designed, obtained data for the study, conducted analysis, interpreted
30 31	17	the results, drafted, and reviewed the manuscript. BOA and AA interpreted the results and
32 33	18	conducted critical review of the manuscript. The final draft was agreed upon by all authors.
34 35	19	
36	20	Data availability statement
37 38	21	DHS data used in this study are available for the public upon request. De-identified data was
39 40	22	accessed from: <u>https://dhsprogram.com/Data/</u> .
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48	40	development and initial validation of a questionnaire to measure help-seeking behaviour in
49 50	41	patients with new onset rheumatoid arthritis. Health Expect. 2015;18(6):2340-55.
50 51	42	90. World Health Organization. Draft protocol. A rapid assessment of health seeking
52	43	behaviour in relation to sexually transmitted disease. 1995.
53	44	
54	45	
55	46	
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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.

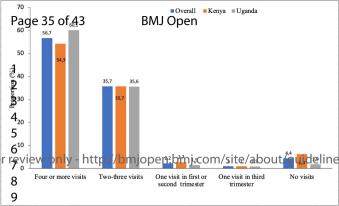
Figure 2. A scatter plot showing correlation between number of antenatal care visits and proportions of facility births and postnatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

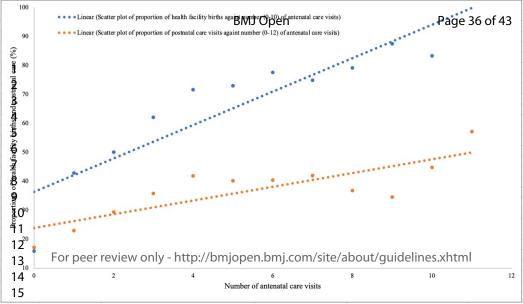
Figure 3. Proportion of hospital and home births by number of antenatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

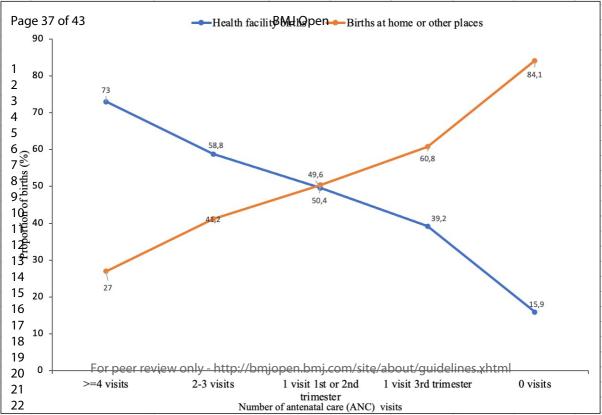
Figure 4: A forest plot showing relative risk ratios (RRR) for the associations between maternal and socio-demographic factors and maternal continuum of care-seeking behaviour in Kenya and Uganda, using demographic and health survey 2014-2016 data.

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.

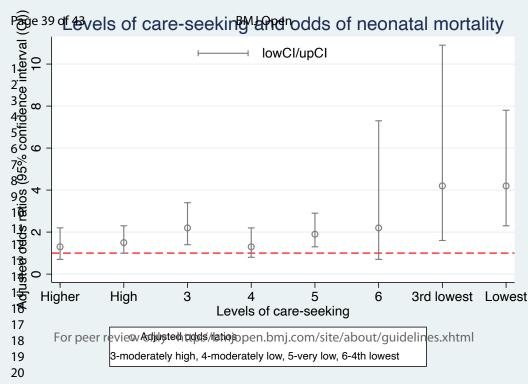


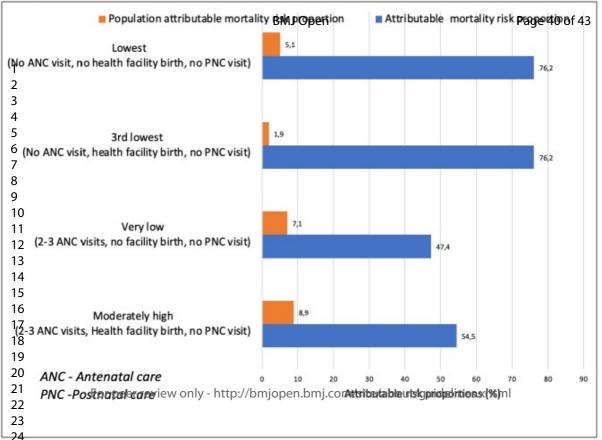


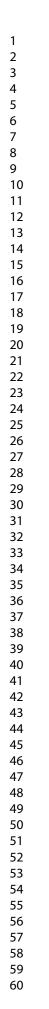


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(≥4 ANC visits, facility birth & PNC). Highest	birth & PNC). Higher	lity (≥4 ANC visits, facility birth & no PNC). High	<i>birth & PNC).</i> Moderately high	Maternal education. Primary vs no education	(1 ANC visit, no facility birth, PNC) 5th lowest	(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
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				Paternal education				
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				Desire a child				
-	e-	-	÷	Yes vs no 🚽	<u> </u>	<u> </u>	<u>+</u>	+
				Mass media exposure				
+	-	+	-	Yes vs no			<u>+</u>	
				Care-seeking decision				
	•	•	•	Both partners vs woman only	-	<u>}</u>	٠	- <u></u>
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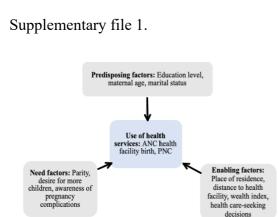


Figure showing behavioral model of utilization of health care services, modified from Andersen and Newman model.

Supplementary file 2.

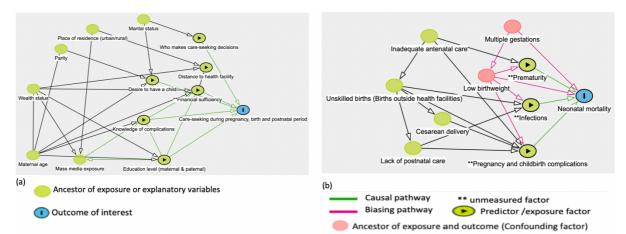


Figure 1: Directed acyclic graphs showing the predictor-outcome relationship for both care-seeking and neonatal survival in Kenya and Uganda, (Developed from <u>www.dagitty.net</u>, using DAGitty version 3.0.)

retror-outcome relationship for both the arrive of the arr

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstra
		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 24-2
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
6		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
1		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
		28. Page 8, lines 1-21
Data sources/	8*	For each variable of interest, give sources of data and details of methods of
measurement		assessment (measurement). Describe comparability of assessment methods if there
		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
		lines 1-16.
Study size	10	Explain how the study size was arrived at. N/A. Described for primary data collect
5		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
		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, line
		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,
		table 4. Page 20 table 5
		(b) Give reasons for non-participation at each stage. Page 9, line 10-16. Page 20 tal
		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-
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 crosssectional, 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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4	2	postnatal and associated neonatal survival outcomes in Kenya and Uganda: analysis of
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8	5	Malachi Ochieng Arunda ¹ (corresponding author) *
9 10	6	Anette Agardh ¹ ,
11 12	7	Benedict Oppong Asamoah ¹
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1 Abstract 2 Objectives: To examine how maternal and sociodemographic factors determine continued 3 care-seeking behaviour from pregnancy to postnatal period in Kenya and Uganda and to 4 determine associated neonatal survival outcomes. 5 Design: A population-based analysis of cross-sectional data using multinomial and binary 6 logistic regressions. 7 Setting: Countrywide, Kenya, and Uganda. 8 Participants: Most recent live births of 24,502 mothers within 1-59 months prior to the 9 2014-2016 demographic and health surveys. 10 Outcomes: Care-seeking continuum and neonatal mortality. 11 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 12 and 41% had facility births and postnatal care, respectively. Maternal/paternal education 13 versus no education were associated with continued care-seeking in majority of care-seeking 14 classes; relative risk ratios, RRR ranged from 2.1–8.0 (95% confidence intervals [95% CI] 15 1.1–16.3). Similarly, exposure to mass media was generally associated with continued care-seeking medency reduced if a 17 husband made major maternal care-seeking duecisions. Transportation problems and living i	1 2		
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3 4	1	Strengths and limitations of this study	
5 6	2	• The nationally representativeness of the data and the large sample size of the study	
7	3	allowed for valid stratified analysis with implications for national policy developments to)
8 9	4	improve neonatal survival outcomes for countries in sub-Saharan Africa region.	
10 11	5		
12	6	• Recall bias may not be completely eliminated from the study since the data was collected	l
13 14	7	retrospectively through interviews.	
15 16	8		
17 18	9	However, by selecting the most recent births and owing to the fact that childbirth is a	
19	10	special event not easily forgettable, the study findings reflect the reality with considerabl	e
20 21	11	validity.	
22 23	12		
24	13	• The study was based on maternal attendance to care and not the actual obstetric services	
25 26	14	received thus aspects related to lack of drugs, inadequate facilities or quality of care were	÷
27 28	15	not captured in our study.	
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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 Kenva 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.

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29 Methods

⁵³₅₄ 30 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

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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].

14 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].

24 Study variables

5 25 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 facili	ty births			
PNC - Yes	Highest	Higher	7 th lowest	_
PNC - No	High	Moderate high	6 th lowest	3 rd lowest
Birth outsid	e of health facili	ity		
PNC - Yes	Slightly high	Moderately lower	5 th lowest	2 nd lowest
PNC - No	Moderately	Very low	4 th lowest	Lowest
	low			
ANC – Antenato	al care, PNC – Posti	natal care, 1 st – first, 2 nd	– 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

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1 35–49 years years old while *place of residence* remained as *rural* and *urban* [46]. Marital 2 status was dichotomized into single or married [47]. A mother having a problem with longer 3 distance/transportation to nearest health facility was classified as 'yes' if it was a problem 4 and `no' if it was not [48]. Desire to have a newborn child, whether or not mother was told 5 about pregnancy complications [49] and having exposure to mass media [50] were all 6 categorized as 'yes' and 'no'. The variable who ultimately makes maternal care-seeking 7 *decisions* was categorized as respondent (woman) alone, husband alone or joint decision [51]. 8 *Education* was categorized as no education, primary education and secondary or higher [52]. 9 *Parity* (number of children ever born) was categorized as primiparous (for first time mothers) 10 para 2-3 (for those with 2-3 children) and para 4+ [46]. Wealth status was classified into poor 11 (poor/poorest), middle and rich(rich/richest) [52, 53]. The wealth status in DHS is indexed 12 based on household cumulative living standards taking into account assets possessed, water 13 and sanitation facilities. Place of residence was classified into rural and urban [53]. 14 Mapping the predictor - outcome relationship using directed acyclic graphs 15 16 Prior to the analysis, the directed acyclic graphs (DAGs) by Textor and colleagues [54] were 17 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 noncausal risk factor for neonatal mortality.

23 Data analysis

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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.

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

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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.

1 2										
3	1									
4 5	2									
6										
7 8	4	period, childbirth and within 28 days postnatal in Kenya and Uganda, using demographic and								
9	5	health survey 2014-2016 data, N=24502.								
10 11		\geq 4 ANC 2-3 ANC visits, 1 ANC visit, 0 ANC visit,								
12			visits, n=13888	n=8744	N=775	N=1095				
13 14		Health facili								
14		PNC - Yes	4961(35.7)	2355(26.9)	115	68(6.2)				
16		PNC - No	5179(37.3)	2782(31.8)	213	106(9.6)				
17 18			e of health facil	v	(2)	101/11 1)				
19		PNC - Yes PNC - No	752(5.4) 2996(21.6)	632(7.2) 2975(34.0)	63 384	121(11.1) 800(73.1)				
20 21			2990(21.0) al care, PNC – Pos	· /	504	800(73.1)				
22	6			,						
23	7	The scatter plo	ot in Figure 2 sh	ows a positive correl	ation between num	iber of antenatal care				
24 25	8	visits and both	proportions of	facility births and PN	NC visits. Further, 1	Figure 3 shows that a				
26 27	$\frac{26}{27}$ 9 single early ANC visit in the 1 st or 2 nd trimester increased the likelihood of healt									
28 29	10	childbirth as opposed to late ANC visit in the 3 rd trimester.								
30 31	11									
32	12									
33 34	13	seeking behaviour from pregnancy to postnatal period. Majority (\geq 46%) of the mothers								
35 36	14	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-								
37 38	15									
39	16									
40 41	17	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-								
42 43	18 19	0,		1 0		seekers had no formal				
44 45	20			e observed among the						
46 47	20		inal tiends were		en nusbands/partic	its (cuucation).				
48	21									
49 50	23									
50 51	24									
52	25									
53 54	26 27									
55	27 28									
56	29									
57 58	30									
59	31									
60	32									

3	Table 2: Distribution of mothers by continuum of care-seeking classes during antenatal
4	period, childbirth and within 28 days postnatal in Kenya and Uganda, using demographic and

to beet teries only

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

	4 or r	nore AN(C visits, n=	13888	2.	-3 ANC vis	its, n=874	44		1 ANC vi	sits, n=77	5	0 ANC visit, n=1027		
	Highest	High	Slightly	Mod-	Higher	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd	Lowes
	(facility	(facilit	high (no	low (no	(facility	high	lower	low (no	lowest	lowest	lowest	lowest	lowest	lowest	t
	birth &	y	facility	facility	birth,	(facility	(no	facility	(facilit	(facility	(no	(no	(facilit	(no	(no
	PNC).	birth,	birth,	birth, no	PNC).	birth, no	facility	birth, no	y y	birth, no	facility	facility	y y	facility	facility
	n (%)	no	PNC).	PNC).	n (%)	PNC).	birth,	PNC).	birth,	PNC)	birth,	birth, no	birth,	birth,	birth,
		PNC).	n (%)	n (%)		n (%)	PNC).	n (%)	PNC)	n (%)	PNC)	PNC)	no	PNC)	no
		n (%)					n (%)		n (%)		n (%)	n (%)	PNC)	n (%)	PNC)
Variables							, í		, í			l ì í	n (%)	l ì í	n (%)
Maternal a	ge (Years)														
15-24	1625	1680	213	815	832	1001	159	778	51	77	20	123	43	36	189
	(32.8)	(32.4)	(28.3)	(27.2)	(35.3)	(36.0)	(25.2)	(26.2)	(44.4)	(36.2)	(31.8)	(32.0)	(40.6)	(29.7)	(23.6)
25-34	2406	2513	315	1410	1064	1240	303	1385	35	91	17	160	41	52	360
	(48.5)	(48.5)	(46.6)	(47.1)	(45.2)	(44.6)	(47.9)	(46.6)	(30.4)	(42.7)	(27.0)	(41.7)	(38.7)	(43.0)	(45.0)
35-49	930	986	189	771	459	541	170	812	29	45	26	101	22	33	251
	(18.7)	(19.1)	(25.1)	(25.7)	(19.5)	(19.4)	(26.9)	(27.3)	(25.2)	(21.1)	(41.2)	(26.3)	(20.7)	(27.3)	(31.4)
Place of re	sidence														
Urban	1669	2096	164	483	677	956	122	409	30	79	14	52	33	18	85
	(33.6)	(40.5)	(21.8)	(16.1)	(28.8)	(34.4)	(19.3)	(13.8)	(26.1)	(37.1)	(22.2)	(13.5)	(31.1)	(14.9)	(10.6)
Rural	3292	3083	588	2513	1678	1826	510	2566	85	134	49	332	73	103	715
	(66.4)	(59.5)	(78.2)	(83.9)	(71.3)	(65.6)	(80.7)	(86.2)	(73.9)	(62.9)	(77.8)	(86.5)	(68.9)	(85.1)	(89.4)
Distance to			<u> </u>			1	1	1		1	1	1	1	1	T
No	3490	1561	472	876	1580	810	379	862	74	60	36	97	34	62	148
	(70.3)	(66.5)	(62.8)	(52.3)	(67.1)	(62.9)	(60.1)	(50.5)	(64.4)	(63.2)	(57.1)	(47.1)	(68)	(51.2)	(42.8)
Yes	1471	785	280	798	775	477	252	844	41	35	27	109	16	59	198
	(29.7)	(33.5)	(37.2)	(47.7)	(32.9)	(37.1)	(39.9)	(49.5)	(35.6)	(36.8)	(42.9)	(52.9)	(32.0)	(48.8)	(57.2)
Maternal e								1							
No	435	389	167	811	241	271	140	726	15	42	18	139	20	63	486
education	(8.8)	(7.5)	(22.2)	(27.1)	(10.2)	(9.8)	(22.2)	(24.4)	(13.0)	(19.7)	(28.6)	(36.2)	(18.9)	(52.0)	(60.8)
Primary	2535	2721	486	1789	1369	1645	399	1960	73	124	37	218	57	52	280
	(51.1)	(52.5)	(64.6)	(59.7)	(58.2)	(59.1)	(63.1)	(65.9)	(63.5)	(58.2)	(58.7)	(56.8)	(53.8)	(43.0)	(35.0)
Mod- Mode	erately.														

	4 or 1	nore ANC	C visits, n=	13888	2	-3 ANC vis	its, n=874	44		1 ANC vi	sits, n=77	5	0 ANC visit, n=1027		
	Highest	High	Slightly	Mod-	Higher	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd	Lowes
	(facility birth & PNC).	(facilit y <i>birth</i> ,	high (no facility birth,	low (no facility birth, no	(facility birth, PNC).	high (facility birth, no	lower (no facility	low (no facility birth, no	lowest (facilit y	lowest (facility birth, no	lowest (no facility	lowest (no facility	lowest (facilit y	lowest (no facility	t (no facility
Variables	n (%)	no PNC). n (%)	PNC). n (%)	<i>PNC).</i> n (%)	n (%)	PNC). n (%)	birth, PNC). n (%)	PNC). n (%)	birth, PNC) n (%)	PNC) n (%)	birth, PNC) n (%)	birth, no PNC) n (%)	birth, no PNC) n (%)	birth, PNC) n (%)	birth, no PNC) n (%)
Secondar y 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/hu	sband edu	cation lev	vel			1	1		1				1	1	1
No	255	128	118	276	142	68	98	259	7	17	13	39	4	52	173
education	(6.1)	(6.5)	(16.9)	(19.1)	(7.4)	(6.5)	(16.8)	(17.5)	(8.4)	(23.0)	(23.2)	(23.8)	(13.8)	(49.5)	(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)
Secondar	2059	851	179	352	777	392	136	280	30	18	11	29	6	10	27
y & higher	(49.3)	(43.2)	(25.6)	(24.4)	(40.2)	(37.3)	(23.4)	(19.0)	(36.1)	(24.3)	(19.6)	(17.7)	(20.7)	(9.5)	(8.7)
Knowledge	about pre	gnancy. I) birth comp	lications (o	nlv Kenva)									
No	537	319	348	286	341	250	349	351	29	23	44	63	-	-	-
	(32.8)	(39.1)	(47.4)	(63.4)	(45.6)	(53.7)	(55.6)	(66.9)	(64.4)	(50.0)	(69.8)	(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 h	ave a child	l,													
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 ultim						(00.1)	(01.0)		(17.1)	(10.0)		(00.0)	(00.0)	1 (70.0)	1 (00.1)
Respond-	1337	548	229	461	600	343	172	416	28	14	16	49	10	18	61
ent alone	(32.7) erately.	(28.6)	(36.6)	(32.2)	(31.9)	(33.0)	(33.0)	(28.9)	(34.2)	(19.4)	(36.4)	(30.2)	(35.7)	(22.2)	(20.7)

	4 or 1	nore ANG	C visits, n=	13888	2	-3 ANC vis	<u>its, n=87</u>	44		1 ANC vis	sits, n=77	5	0 ANC visit, n=1027			
	Highest	High	Slightly	Mod-	Higher	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd	Lowe	
	(facility	(facilit	high (no	low (no	(facility	high	lower	low (no	lowest	lowest	lowest	lowest	lowest	lowest	t	
	birth &	y	facility	facility	birth,	(facility	(no	facility	(facilit	(facility	(no	(no	(facilit	(no	(no	
	PNC).	birth,	birth,	birth, no	PNC).	birth, no	facility	birth, no	y y	birth, no	facility	facility	$\begin{vmatrix} 0 \\ y \end{vmatrix}$	facility	facilit	
	n (%)	no	PNC).	PNC).	n (%)	PNC).	birth,	PNC).	birth,	PNC)	birth,	birth, no	birth,	birth,	birth,	
		PNC).	n(%)	n (%)		n(%)	PNC).	n(%)	PNC)	n(%)	PNC)	PNC)	no	PNC)	no	
		n (%)		II (70)			n(%)		n (%)	<i>n</i> (70)	n (%)	n(%)	PNC)	n(%)	PNC)	
Variables		1 (70)					<i>n</i> (70)		<i>n</i> (70)		1 (70)	1 (70)	n (%)		n(%)	
Both	1776	834	236	600	834	437	186	612	32	36	13	56	8	31	134	
Dotti	(43.5)	(43.4)	(37.8)	(41.9)	(44.3)	(42.1)	(35.7)	(42.4)	(39.0)	(50.0)	(29.6)	(34.6)	(28.6)	(38.3)	(45.6)	
Husband	973	537	160	370	448	258	163	414	22	22	15	57	10	32	99	
alone	(23.8)	(28.0)	(25.0)	(25.9)	(23.8)	(24.9)	(31.3)	(28.7)	(26.8)	(30.6)	(34.1)	(35.2)	(35.7)	(39.5)	(33.7)	
Parity	(25.0)	(20.0)	(25.0)	(25.7)	(23.0)	(24.9)	(31.5)	(20.7)	(20.0)	(30.0)	(34.1)	(33.2)	(55.7)	(5).5)	(55.7)	
Primiparo	1293	1388	96	324	555	715	68	295	32	53	10	53	28	13	98	
*	(26.1)	(26.8)	(12.8)	(10.8)	(23.6)	(25.7)	(10.8)	(9.9)	(27.8)	(24.9)	(15.9)	(13.8)	(26.4)	(10.7)	(12.3)	
us D 2.2	1877	2113	287	988	855	1061	219	906	28	72	16	108	33	36	200	
Para 2-3	(37.8)	(40.8)	(38.2)	(33.0)	(36.3)	(38.1)	(34.7)	(30.5)	(24.4)	(33.8)	(25.4)	(28.1)	(31.1)	(29.8)	(25.0)	
Para 4+	1791	1678	369	1684	945	1006	(34.7)	1774	55	88	37	223	45	(29.8)	502	
Para 4+	(36.1)	(32.4)	(49.0)	(56.2)	(40.1)	(36.2)	(54.6)	(59.6)	(47.8)	(41.3)	(58.7)	(58.1)	(42.5)	(59.5)	(62.7)	
Wealth sta		(32.4)	(49.0)	(30.2)	(40.1)	(30.2)	(34.0)	(39.0)	(47.8)	(41.3)	(30.7)	(38.1)	(42.3)	(39.3)	(02.7)	
	1785	1739	497	1953	994	1181	446	2108	52	106	50	285	43	103	684	
Poor	(36.0)	(33.6)	(66.1)	(65.2)	(42.2)	(42.5)	(70.6)	(70.9)	(45.2)	(49.8)	(47.2)	(74.2)	(68.3)	(85.1)	(85.5)	
Middle	854	1031	132	556	457	565	127	498	24	44	20	60	10	15	51	
Middle	854 (17.2)		(17.6)	(18.5)	(19.4)	(20.3)		498 (16.7)	(20.9)	(20.7)	(18.9)		(15.9)	(12.4)	(6.4)	
Dist	2322	(19.9) 2409	123	487	904	1036	(20.1) 59	369	39	63		(15.6) 39	10	3	65	
Rich	(46.8)	(46.5)	(16.4)	(16.3)	(38.4)	(37.2)	(9.3)	(12.4)	(33.9)	(29.6)	36 (34.9)	(10.29	(15.9)	(2.5)	(8.1)	
Marital sta		(40.3)	(10.4)	(10.3)	(38.4)	(37.2)	(9.3)	(12.4)	(33.9)	(29.0)	(34.9)	(10.29	(13.9)	(2.3)	(8.1)	
		000	100	425	161	402	100	450	22	55	10	00	20	20	100	
Single	859	880	123	435	464	403	109	458	33	55	19	90	38	39 (32.2)	123	
	(17.3)	(17.0)	(16.4)	(14.5)	(19.7)	(20.6)	(17.3)	(15.4)	(28.7)	(25.8)	(30.2)	(23.4)	(35.9)		(15.4)	
Married	4102	4299	629	2561	1891	1558	523	2517	82	158	44	294	68	82	677	
N.T	(82.7)	(83.0)	(83.6)	(85.5)	(80.3)	(79.5)	(82.7)	(84.6)	(72.3)	(74.2)	(69.8)	(76.6)	(64.1)	(67.8)	(84.6)	
Mass medi	a exposure	9														

	4 or 1	nore ANG	C visits, n=	13888	2	-3 ANC vis	its, n=874	44		1 ANC vis	sits, n=77	5	0 AN	C visit, n	=1027
	Highest (facility	High (facilit	Slightly high (no	Mod- low (no	Higher (facility	Mod- high	Mod- lower	Very low (no	7 th lowest	6 th lowest	5 th lowest	4 th lowest	3 rd lowest	2 nd lowest	Lowes
	birth &	v v	facility	facility	birth,	<i>(facility</i>)	(no	facility	<i>(facilit)</i>	<i>(facility</i>	(no	(no	<i>(facilit)</i>	(no	(no
	PNC).	birth,	birth,	birth, no	PNC).	birth, no	facility	birth, no	v	birth, no	facility	facility		facility	facility
	n (%)	no	PNC).	PNC).	n (%)	PNC).	birth,	PNC).	birth,	PNC)	birth,	birth, no	birth,	birth,	birth,
		PNC).	n (%)	n (%)		n (%)	PNC).	n (%)	PNC)	n (%)	PNC)	PNC)	no	PNC)	no
		n (%)					n (%)		n (%)		n (%)	n (%)	PNC)	n (%)	PNC)
Variables													n (%)		n (%)
No	804	484	733	521	204	993	176	1105	26	56	17	170	27	61	508
	(16.2)	(20.6)	(14.1)	(18.7)	(27.1)	(33.2)	(27.9)	(37.1)	(22.6)	(26.3)	(27.0)	(44.3)	(25.5)	(50.4)	(36.6)
Yes	4157	1871	4446	2261	548	2001	456	1870	89	157	46	214	79	60	291
Mod- Mode	(83.8)	(79.4)	(85.9)	(81.3)	(72.9)	(66.8)	(72.1)	(62.9)	(77.4)	(72.7)	(73.0)	(55.7)	(74.5)	(49.6)	(36.4)
						1									

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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

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53	43
54 55	44
55 56	45
57	46
58	47
59	48

random classes, the rest were not statistically significant. Additionally, being rich indicated

to beet terren ont

almost no significant association with care-seeking. Figure 4 summarizes in a forest plot,

selected (extremes) results from table 4.

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

	Highest	Higher	High	Mod-	Slightly	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd
	(≥4	(2-3	$(\geq 4 ANC)$	high	high	low (≥4	lower	low (2-3	lowest	lowest	lowest	lowest	lowest	lowest
	ANC	ANC	visits,	(2-3	(≥4	ANC	(2-3	ANC	(1 ANC	(1 ANC	(1 ANC	(1 ANC	(No	(No
	visits,	visits,	facility	ANC	ANC	visits, no	ANC	visits,	visit,	visit,	visit, no	visit, no	ANC	ANC
	facility	facility	birth,	visits,	visits,	facility	visits,	no	facility	facility	facility	facility	visit,	visits,
Variables	birth &	birth,	no	facility	no	birth, no	no	facility	birth,	birth, no	birth,	birth,	facility	no
	PNC).	PNC).	PNC).	birth, no	facility	PNC).	facility	birth, no	PNC)	PNC)	PNC)	no	birth,	facility
				PNC).	birth,		birth,	PNC).	,	, ,	Í	PNC)	no PNC)	birth,
				,	PNC).		PNC).					,		PNC)
			Versus lo	west (no ANG	C, no facility	y birth, no PN	C) care-see	king level, 9	5% Confiden	ce Interval (9	5%CI)			
Maternal ed	lucation lev	vel												
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
education						5								
Primary	3.2	3.2	3.4	2.7	2.1	2.3	2.1	2.8	2.6	1.5	1.7	1.7	2.6	0.9
	(2.3-4.4)	(2.2,4.6)	(2.4-4.9)	(1.9-4.0)	(1.5-3.1)	(1.6-3.2)	(1.5-3.2)	(2.0-4.0)	(1.2-5.7)	(0.7-3.0)	(0.8-3.8)	(1.0-2.8)	(0.8-9.0)	(0.5-1.
Secondary	8.0	6.9	6.9	4.9	2.5	3.1	3.9	2.9	3.4	1.7	2.1	1.5	4.3	0.6
& higher	(4.0- 16.3)	(3.3-14.1)	(3.4,14.2)	(2.3-10.2)	(1.2-5.4)	(1.5-6.4)	(1.8-8.4)	(1.7-4.9)	(1.1-10.7)	(0.5-5.4)	(0.6-8.2)	(0.5-4.1)	(0.8,23.0)	(0.1-2.9
Partner/hus	band educ	ation level	l	•	•						•	•		
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
education														
Primary	3.3	3.4	3.6	4.7	2.6	2.1	2.7	2.7	3.4	1.9	1.9	2.5	_	1.2
-	(2.4-4.7)	(2.4-5.0)	(2.5-5.3)	(3.1-7.1)	(1.8-3.9)	(1.5-3.1)	(1.8-4.0)	(1.9-3.8)	(1.3-8.7)	(0.9-4.1)	(0.8-4.4)	(1.5-4.4)		(0.7-2.2
Secondary	6.4	5.5	6.2	7.2	3.7	3.0	3.4	2.9	6.0	2.3	2.1	3.3	-	1.2
& higher	(3.8-10.6)	(3.2-9.2)	(3.7-10.6)	(4.1-12.7)	(2.1-6.5)	(1.8-5.1)	(1.9-6.0)	(1.7-4.9)	(2.1-17.4)	(0.9-6.1)	(0.7-6.3)	(1.5-6.9)		(0.5-3.
Distance to	/	alth facilit	y is a big p	roblem	1	1	I	1	1	1	1		1	
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	0.6	0.6	0.7	0.7	0.6	0.8	0.7	0.8	0.7	0.6	0.7	1.1	0.6	0.8
	(0.5-0.8)	(0.5-0.8)	(0.5-0.9)	(0.5-0.9)	(0.5-0.8)	(0.6-1.0)	(0.5-0.9)	(0.6-1.1)	(0.4-1.2)	(0.3-1.0)	(0.4-1.3)	(0.7-1.6	(0.3-1.4)	(0.5-1.
Desire to ha	ve a child,					<u> </u>	<u> </u>	<u> </u>	<u> </u>					I
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

1 2 3 4 5	
5 6 7 8 9 10	
11 12 13 14	
15 16 17 18 19	
20 21 22 23 24	
25 26 27 28 29	
30 31 32 33 34	
35 36 37 38 39	
40 41 42 43	
44 45 46	

	Highest	Higher	High	Mod-	Slightly	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd
	(≥4	(2-3	$(\geq 4 ANC)$	high	high	low (≥4	lower	low (2-3	lowest	lowest	lowest	lowest	lowest	lowest
	ANC	ANC	visits.	(2-3	(≥4	ANC	(2-3	ANC	(1 ANC	(1 ANC	(1 ANC	(1 ANC	(No	(No
	visits,	visits.	facility	ANC	ANC	visits, no	ANC	visits,	visit,	visit.	visit, no	visit, no	ANC	ANC
	facility	facility	birth.	visits.	visits,	facility	visits,	no	facility	facility	facility	facility	visit,	visits,
Variables	birth &	birth.	no	facility	no	birth, no	no	facility	birth.	birth, no	birth,	birth,	facility	no
, an abies	PNC).	PNC).	PNC).	birth, no	facility	PNC).	facility	birth, no	PNC)	PNC)	PNC)	no	birth.	facilit
	1110).	1100).		PNC).	birth.	1100).	birth,	PNC).	1100)	11(0)		PNC)	no PNC)	birth,
				1110).	PNC).		PNC).	1110).				1110)		PNC)
			Versus <i>lo</i>	west (no AN	/ .	, hirth no PN		king level 9	5% Confider	ce Interval (9	5%CI)			1110)
Yes	1.5	1.3	1.6	1.2	1.3	1.4	0.9	1.3	0.7	0.8	0.5	1.0	0.5	0.4
105	(1.0-2.2)	(0.9-2.0)	(1.1-2.4)	(0.8-1.8)	(0.8-2.0)	(1.0-2.2)	(0.5-1.3)	(0.9-2.0)	(0.3-1.4)	(0.4-1.7)	(0.2-1.2)	(0.6-1.8)	(0.2-1.7)	(0.2-0.)
Mass media	exposure													
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	3.2	2.7	2.7	2.7	3.0	2.1	3.0	1.8	2.9	1.6	3.2	1.5	2.0	2.0
	(2.4-4.2)	(2.0-3.6)	(2.0-3.6)	(2.0-3.7)	(2.2-4.1)	(1.6-2.8)	(2.2-4.2)	(1.4-2.4)	(1.6-5.4)	(0.9-3.0)	(1.6-6.3)	(1.0-2.4)	(0.8-4.8)	(1.2-3.)
Told about	pregnancy.	, birth con	nplications	(only Keny	a) Versus	very low can	re-seeking l	evel					· · · ·	
No	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	_	_	-	-	_	-	_
Yes	2.6	1.7	2.1	1.1	2.0	1.2	1.5	_	_	_	-	_	-	_
	(2.0-3.2)	(1.3-2.2)	(1.7-2.8)	(1.0-1.7)	(1.6-2.5)	(0.9-1.6)	(1.2-1.9)							
Who ultima	tely makes	care-seek	ing decisio	ns										
Respond-	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
ent alone														
Both	0.5	0.6	0.6	0.5	0.5	0.5	0.5	0.7	0.5	1.3	0.4	0.5	0.4	0.9
	(0.4-0.8)	(0.4-0.8)	(0.4-0.9)	(0.4-0.8)	(0.3-0.7)	(0.4-0.8)	(0.3-0.7)	(0.5-0.9)	(0.3-0.9)	(0.6-2.5)	(0.2-0.9)	(0.3-0.9)	(0.1-1.0)	(0.5-1.)
Husband	0.5	0.5	0.7	0.5	0.5	0.5	0.7	0.7	0.5	1.1	0.6	0.7	0.7	1.1
alone	(0.4-0.7)	(0.4-0.7)	(0.5-0.9)	(0.3-0.7)	(0.3-0.7)	(0.3-0.7)	(0.4-1.0)	(0.5-0.9)	(0.3-1.0)	(0.5-2.5)	(0.3-1.4)	(0.4-1.2)	(0.3-1.8)	(0.6-2.2
Maternal ag	ge (Years)													
15-24	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
25-34	0.9	0.7	0.6	0.6	0.9	0.6	0.9	0.6	0.4	0.8	0.4	0.5	0.5	0.5
	(0.6-1.3)	(0.5-1.1)	(0.4-1.0)	(0.4-0.9)	(0.5-1.3)	(0.4-0.9)	(0.6-1.5)	(0.4-1.0)	(0.2-0.8)	(0.3-1.7)	(0.2-1.2)	(0.3-0.9)	(0.2-1.3)	(0.1-1.
35-49	0.8	0.6	0.6	0.5	0.9	0.5	0.8	0.6	0.4	0.9	0.8	0.6	0.3	0.3
	0.5-1.3	(0.4-1.1)	(0.4-1.0)	(0.3-0.8)	(0.5-1.5)	(0.3-0.8)	(0.5-1.5)	(0.4-1.1)	(0.1-0.9)	(0.3-2.4)	(0.3-2.3)	(0.3-1.2)	(0.1-1.4)	(0.1-0.
Place of resi	danaa													

,	Highest	Higher	High	Mod-	Slightly	Mod-	Mod-	Very	7 th	6 th	5 th	4 th	3 rd	2 nd
, P	(≥4	(2-3	$(\geq 4 ANC)$		high	low (≥4	lower	low (2-3	lowest	lowest	lowest	lowest	lowest	low
, I	ANC	ANC	visits,	(2-3	(≥4	ANC	(2-3	ANC	(1 ANC	(1 ANC	(1 ANC	(1 ANC	(No	(No
1	visits,	visits,	facility	ANC	ANC	visits, no	ANC	visits,	visit,	visit,	visit, no	visit, no	ANC	ANC
1	facility	facility	birth,	visits,	visits,	facility	visits,	no	facility	facility	facility	facility	visit,	visit
Variables	birth &	birth,	no	facility	no	birth, no	no	facility	birth,	birth, no	birth,	birth,	facility	no
·	PNC).	PNC).	PNC).	birth, no	facility	PNC).	facility	birth, no	PNC)	PNC)	PNC)	no	birth,	faci
, i				PNC).	birth,	ĺ ĺ	birth,	PNC).	, í			PNC)	no PNC)	birth
					PNC).		PNC).	'						PNC
						y birth, no Pl	NC) care-see			nce Interval (9	/5%CI)			
Urban	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Rural	0.4	0.4	0.3	0.4	0.4	0.7	0.4	0.7	0.3	0.2	0.4	0.6	0.5	0.4
	(0.2-0.6)	(0.2-0.6)	(0.2-0.5)	(0.3-0.7)	(0.2-0.6)	(0.4-1.1)	(0.2-0.6)	(0.4-1.1)	(0.2-0.7)	(0.1-0.4)	(0.2-1.0)	(0.3-1.2)	(0.2-1.5)	(0.2-
Marital statu														
Single	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Married	1.9	1.7	2.0	2.0	0.6	2.4	0.5	1.6	1.5	1.9	0.3	1.9	1.0	0.2
	(1.1-3.3)	(1.0-3.0)	(1.2-3.5)	(1.1-3.7)	(0.3-1.0)	(1.3-4.3)	(0.3-1.0)	(0.9-2.8)	(0.5-4.5)	(0.6-6.9)	(0.1-0.6)	(0.7-5.3)	(0.2-4.5)	(0.1-
Wealth status			D.C.			D.C.		- D. C	- D. C		D.C.	D.C.	- D (
Poor	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Middle	1.8	2.0	2.2	1.9	1.3	1.9	1.3	1.5	2.7	2.6	1.4	1.8	1.7	0.9
Rich	(1.1-3.0)	(1.2-3.3)	(1.3-3.6)	(1.1-3.2)	(0.8-2.2)	(1.2-3.2)	(0.8-2.2)	(0.9-2.6)	(1.3-5.6)	(1.2-5.9)	(0.6-3.3)	(0.9-3.4)	(0.5-5.4)	0.1
Rich	(0.8-2.0)	$\left \begin{array}{c} 1.2 \\ (0.7-1.8) \end{array} \right $		(0.7-1.8)	(0.4)	(0.8)	0.2 (0.1-0.3)	0.6 (0.4-0.9)	(1.5-2.4)	(0.6-2.9)	(0.3)	(0.4)	(0.4-3.6)	(0.0
Parity	(0.0-2.0)	(0.7-1.0)	(0.0-1.7)	(0.7-1.0)	(0.2-0.7)	(0.5-1.5)	(0.1-0.5)	(0.4-0.7)	(1.3-2.4)	(0.0-2.7)	(0.1-1.1)	(0.2-0.7)	(0.4-5.0)	1 (0.0
Primiparous	Ref.	Ref.	Ref.	Ref.	Ref	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Para 2-3	0.9	1.1	1.1	1.1	1.6	1.7	2.0	1.9	1.1	0.9	0.9	1.5	1.9	2.7
I ala 2 5	(0.6-1.5)	(0.6-1.8)		(0.6-1.8)	(0.9-2.8)	(1.0-2.9)	(1.1-3.6)	(1.1-3.2)	(0.5.2.7)	(0.3-2.3)	(0.3-2.6)	(0.7-3.3)	(0.5-6.8)	(1.0
/	, ,	, ,						, ,				, í		Ì
Para 4+	0.7	0.9	0.9	1.1	2.2	2.3	1.6	2.5	1.9	0.9	0.9	2.1	1.0	2.8
P	(0.4-1.2)	(0.5-1.6)	(0.5-1.6)	(0.6-1.9)	(0.6-2.2)	(1.3-4.0)	(0.8-3.1)	(1.4-4.5)	(0.7-5.2)	(0.3-2.7)	(0.3-3.1)	(0.9-5.1)	(0.2-4.9)	(0.9

:		care-seeking behaviour	Overall Crude odds ratio (95% CI)	overali aOR* (95% CI)	Proportion of the total in Kenya (%)	Kenya only aOR* (95% CI)	Proport- ion of the total in Uganda	only aOR* (95%
)	17	demographic and health surv Classes of	vey 2014-20 Overall	016 data. Overall	Duonoution	Vanua	Duanaut	Uganda
;	15 16	5						
, ,	14	seeking continued care at highest level were more than twice (33.8%) that of Kenya (13.4%)						
;	13	significant aOR 2.5 (95% CI 1.0-6.0). We observe that the proportion of Ugandan mothers						
}	12	death, aOR 1.7 (95% CI 1.1-2.7) and <i>lowest</i> class showed higher odds but was marginally not						
,	11	likely to die. For Uganda, only very low category was significantly associated with neonatal						
)	10	significantly associated with neonatal deaths and neonates in the <i>lowest</i> class were 6 times						
,	9	lowest, very low, moderately low, moderately high, and high versus highest were all						
; ;	8	low) did not indicate any sta	tistically sig	gnificant as	ssociation wit	h mortality.	For Kenya	only,
•	7	-2.4 for the two classes. He	wever, the	remaining	two categorie	es (4^{th} lowes	t and moder	rately
-	6	levels of care-seeking also s	howed sign	ificant high	ner odds of ne	eonatal deat	h; aOR rang	ged 1.9
)	5	aOR 4.2, (95% CI _{range} 1.6–1	0.9). For jo	int Kenya a	nd Uganda, <i>r</i>	noderately	high and ver	ry low
	4	lowest and lowest categories	were assoc	ciated with	about 4-folds	odds of ne	onatal morta	ality,
	3 shows a forest plot of adjusted odds ratios (aOR) for overall results in Table 5. Overall, <i>3rd</i>							, 3rd
	2 categories and neonatal mortality, with the <i>highest</i> category as the reference class. Fi						e class. Figu	ure 5
	1	Table 5 presents the odds ra	tios for the	association	s between co	ntinued care	e-seeking	

benaviour	odds ratio (95% CI)	(95% CI)	in Kenya (%)	aOR* (95% CI)	total in Uganda (%)	aOR* (95% CI)
	n=22538		n=12579		n=9959	,
Highest (\geq 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 (\geq 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 $(\geq 4 ANC)$ 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
4th 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)	_
3rd lowest (<i>No ANC, health facility births and no PNC</i>). <i>Mis=2</i>	7.8 (3.5-17.5)	4.2 (1.6-10.9)	(0.5)	_	(0.4)	_
Lowest (<i>No ANC, no facility</i> <i>births and no PNC.</i>). <i>Mis=17</i> *adjusted/restricted to birthweight	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 \geq 2500 g and singleton births. *Mis* – *Missing: Due to non-response, proportionally* (relatively random) distributed across all strata.

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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.

18 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

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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 \geq 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 vet 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.

30 For mothers with problems with distance to the nearest health facility, strengthening,

55 31 structuring, and funding the community health workers strategy to engage families,

57 32 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

⁶⁰ 34 example have achieved profound improvement in promoting maternal care-seeking [73].

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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 Kenva 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.

23 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.

1 2		
3	1	Acknowledgments
4 5	2	Much appreciation to the DHS programme and partners for availing the datasets for this
6 7	3	study.
8 9	4	
10 11	5	Competing interest statement
12	6	No competing interests were reported by the authors.
13 14	7	
15 16	8	Ethics and dissemination
17	9	DHS data collection process and storage guaranteed the anonymity and confidentiality of
18 19	10	participants. Datasets are publicly available and permission for access and use was obtained
20 21	11	after sending to the request to the DHS secretariat.
22 23	12	
24	13	Funding
25 26	14	No funds were obtained from any entity or industry by the authors of this study.
27 28	15	
29 30	16	Authors' contributions
31	17	MOA conceptualized, designed, obtained data for the study, conducted analysis, interpreted
32 33	18	the results, drafted, and reviewed the manuscript. BOA and AA interpreted the results and
34 35	19	conducted critical review of the manuscript. The final draft was agreed upon by all authors.
36	20	
37 38	21	Data sharing statement: https://dhsprogram.com/data/available-datasets.cfm
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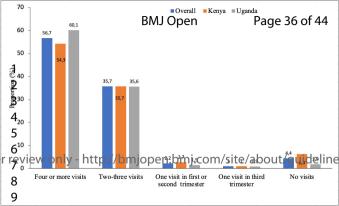
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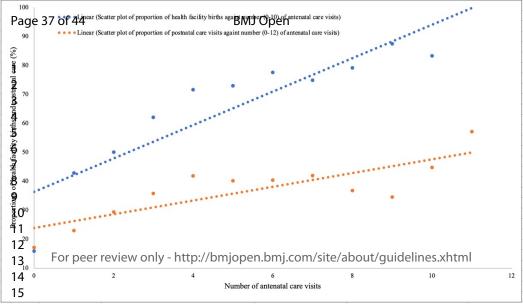
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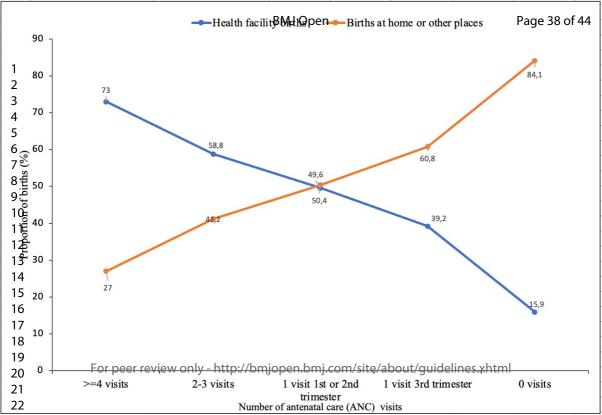
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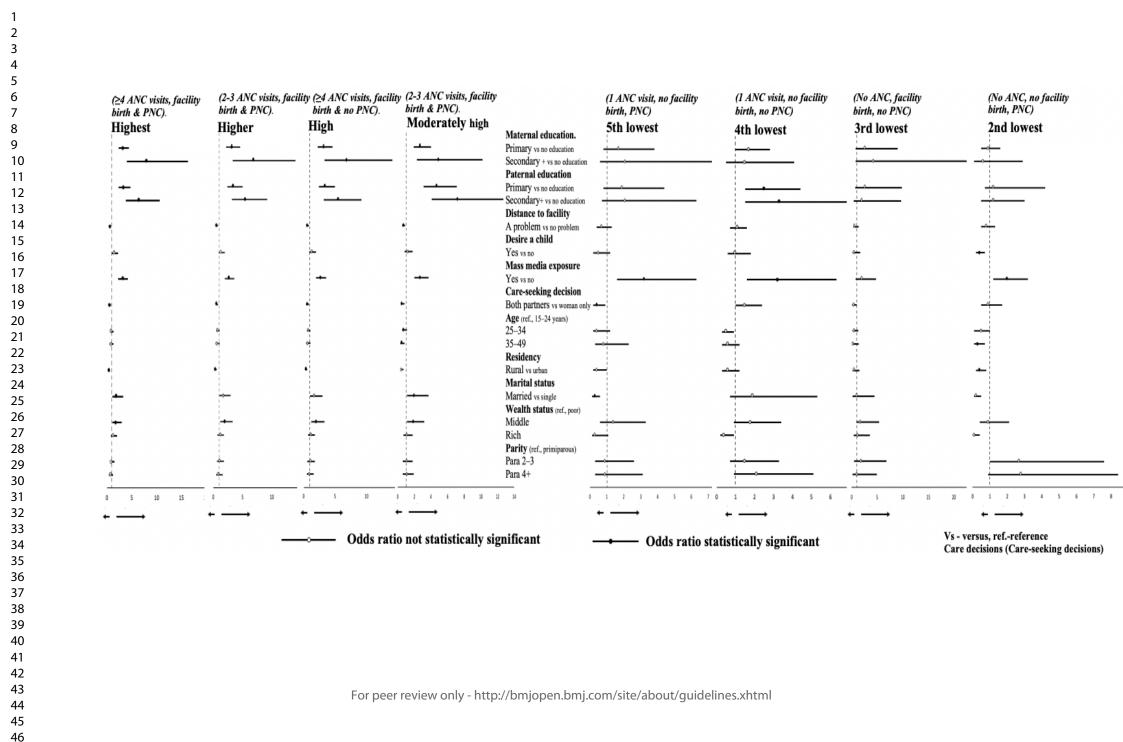
Agarwal S, Abuya T, Kintu R, Mwanga D, Obadha M, Pandya S, et al. Understanding 74. community health worker incentive preferences in Uganda using a discrete choice experiment. J Glob Health. 2021;11:07005. Kenya Moh-. Kenya Standards and Guidelines for mHealth Systems. 2017. 75. 76. Kamulegeya LH, Ssebwana J, Abigaba W, Bwanika JM, Musinguzi D, editors. Mobile Health in Uganda: A Case Study of the Medical Concierge Group2019. Lang'at E. Mwanri L. Temmerman M. Effects of implementing free maternity service 77. policy in Kenya: an interrupted time series analysis. BMC Health Serv Res. 2019;19(1):645. Atuove KN, Barnes E, Lee M, Zhang LZ. Maternal health services utilisation among 78. primigravidas in Uganda: what did the MDGs deliver? Global Health. 2020;16(1):40. Njuguna J, Kamau N, Muruka C. Impact of free delivery policy on utilization of 79. 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. Gitobu CM, Gichangi PB, Mwanda WO. The effect of Kenya's free maternal health 82. 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. Ministry of Health Kenya. Linda Mama Programme positioning Kenya on the 83. Pathway to UHC, Health PS, 2020. World Health Organization. A rapid assessment of health seeking behaviour in 84. relation to sexually transmitted disease. 1995. Nachinab GT, Adjei CA, Ziba FA, Asamoah R, Attafuah PA. Exploring the 85. Determinants of Antenatal Care Services Uptake: A Qualitative Study among Women in a Rural Community in Northern Ghana. J Pregnancy. 2019;2019:3532749. Kyei-Nimakoh M, Carolan-Olah M, McCann TV. Access barriers to obstetric care at 86. health facilities in sub-Saharan Africa-a systematic review. Syst Rev. 2017;6(1):110. Xu K, Evans DB, Kadama P, Nabyonga J, Ogwal PO, Nabukhonzo P, et al. 87. Understanding the impact of eliminating user fees: utilization and catastrophic health expenditures in Uganda. Soc Sci Med. 2006;62(4):866-76. Musa A, Chojenta C, Geleto A, Loxton D. The associations between intimate partner 88. violence and maternal health care service utilization: a systematic review and meta-analysis. BMC Womens Health. 2019;19(1):36. Stack RJ, Mallen CD, Deighton C, Kiely P, Shaw KL, Booth A, et al. The 89. 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.

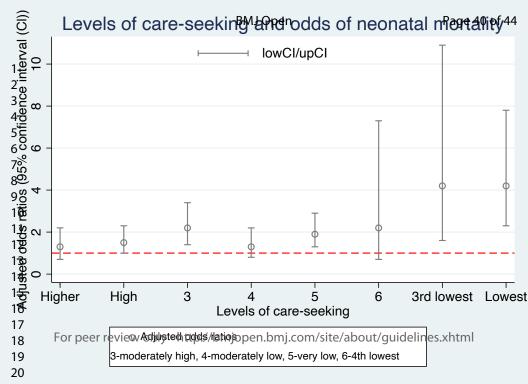
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3	1	Figures and supplementary files
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5	3	Figure legends
6	4	rigure regenus
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8	5	Figure 1: Proportions of antenatal care visits by number of ANC contacts in Kenya and
9	6	Uganda, using demographic and health survey 2014-2016 data.
10	7	
11	8	Figure 2. A scatter plot showing correlation between number of antenatal care visits and
12	9	proportions of facility births and postnatal care visits in Kenya and Uganda, using
13	10	demographic and health survey 2014-2016 data.
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16	12	Figure 3. Proportion of hospital and home births by number of antenatal care visits in Kenya
17	13	and Uganda, using demographic and health survey 2014-2016 data.
18 10	14	
19 20	15	Figure 4: showing relative risk ratios (RRR) for the associations between maternal and
20 21	16	socio-demographic factors and maternal continuum of care-seeking behaviour in Kenya and
21	17	Uganda, using demographic and health survey 2014-2016 data
22	18	
23	19	Figure 5: A forest plot showing adjusted odds ratios between
25	20	
26		continued care-seeking behavioral classes/levels and neonatal mortality,
27	21	using Kenya and Uganda, 2014-2016 demographic and health survey data.
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29	23	Figure 6: Attributable and population attributable neonatal mortality risk
30	24	proportion for lower categories of care-seeking in Kenya and Uganda, using
31	25	demographic and health survey 2014-2016 data
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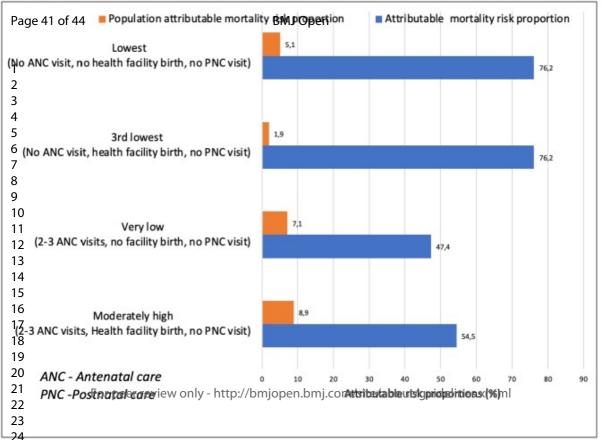












Supplementary file 1.

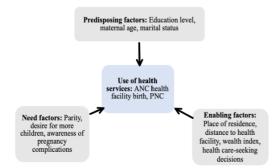


Figure showing behavioral model of utilization of health care services, modified from Andersen and Newman model.

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Supplementary file 2.

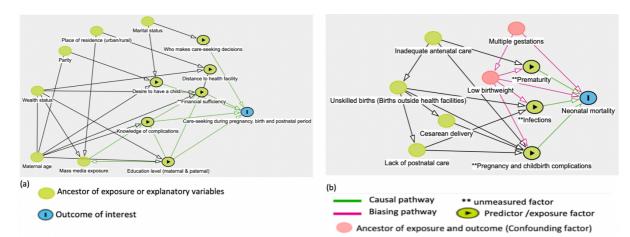


Figure 1: Directed acyclic graphs showing the predictor-outcome relationship for both care-seeking and neonatal survival in Kenya and Uganda, (Developed from <u>www.dagitty.net</u>, using DAGitty version 3.0.)

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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/	8*	For each variable of interest, give sources of data and details of methods of
measurement		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	(<i>a</i>) 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.