Continuity of care and its determinants of routine maternal and newborn health visits in Nepal: Evidence from a nationally representative household survey

Resham Bahadur Khatri (rkchettri@gmail.com)
Health Social Science and Development Research Institute, Kathmandu

Rajendra Karkee
School of Public Health and Community Medicine, BP Koirala Institute of Health Sciences, Dharan,

Jo Durham
School of Public Health and Social Work, Queensland University of Technology, Brisbane

Yibeltal Assefa
School of Public Health, Faculty of Medicine, University of Queensland, Brisbane

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Continuity of care and its determinants of routine maternal and newborn health visits in Nepal: Evidence from a nationally representative household survey

Resham B Khatri[1, 2]*, Rajendra Karkee[3], Jo Durham[1, 4], Yibeltal Assefa[1]

[1] School of Public Health, Faculty of Medicine, University of Queensland, Brisbane, Australia.

[2] Health Social Science and Development Research Institute, Kathmandu, Nepal

[3] School of Public Health and Community Medicine, BP Koirala Institute of Health Sciences, Dharan, Nepal.

[4] School of Public Health and Social Work, Queensland University of Technology, Brisbane, Australia

***Corresponding author (E-mail):** rkchettri@gmail.com

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Abstract

Background

Maternal and newborn health (MNH) is a priority health issue in Nepal, has high maternal and neonatal deaths. Maternal and neonatal deaths can be prevented through uptake of essential antenatal, intrapartum, and postnatal interventions received during routine MNH visits. Not all women, however, receive all recommended routine visits across the MNH Continuum of Care (CoC) in Nepal. This study examined the patterns and determinants of (dis)continuity of care across the MNH continuum.

Methods

The study included 1,978 women aged 15–49 years who had a live birth in the two years preceding the survey. Data were derived from the Nepal Demographic and Health Survey (NDHS) 2016. The outcome variable was (dis)continuity of care at different stages of MNH visits (at least four antenatal care (4ANC) visits, institutional delivery, and postnatal care (PNC) visit). Several structural, intermediary and health system explanatory variables were included in the analysis. Multinomial logistic regression analysis was conducted, and the magnitude of (dis)continuity of care was reported as relative risk ratios (RR) with 95% confidence intervals (CIs). The statistical significance level was set $p<0.05$.

Results

More than two-in-five (41%) women in Nepal received all three MNH visits across the CoC. There was high risk of discontinuity of care during months or weeks prior to childbirth or around childbirth. Higher risk of discontinuation across the CoC was reported among women of disadvantaged ethnic groups, lower wealth status and illiterate. Similarly, women who speak Bhojpuri, provinces six and seven, who had higher birth order (≥4), who involved in agricultural sector, had unwanted last birth had higher risk of discontinuation of MNH visits. Women did not complete all MNH visits if they had poor awareness on health mother groups and if they perceived problem of not having female healthcare providers.

Conclusions

Women had poor completion of all routine MNH visits. High discontinuation was observed among disadvantaged groups across the COC. Regular monitoring using the composite indicator of continuity of care through routine health management information system is required. Program approaches should focus on disadvantaged

women to improve the completion of routine MNH visits and uptake of essential interventions.

Keywords: continuum of care, maternal and newborn health, determinants, routine visits, essential interventions

Introduction

Maternal and newborn health (MNH) is a priority public health issue in low- and lower-middle-income countries (LMICs). Most maternal and newborn deaths occur in Sub-Saharan Africa and South Asia [1]. The majority of the maternal and newborn deaths could be prevented through uptake of essential antenatal, intrapartum and postnatal interventions [2]. The World Health Organization (WHO) recommends women should receive health interventions during routine MNH visits such as at least four antenatal care (4ANC) visits, institutional delivery assisted by skilled health providers [3], at least three PNC visits within the first week after childbirth [4].

A study of 75 LMICs high burden of maternal and neonatal deaths estimated increased access and quality of essential MNH interventions could reduce up to 71% of neonatal deaths, 33% of stillbirths, and 54% of maternal deaths annually [5]. The coverage of routine MNH visits during maternity period, however, is often low and characterised by high rates of discontinuation along the continuum of care (CoC). For example, the completion of all routine MNH visits was low in several LMICs [6-9], including in Ghana [10], Cambodia [6], and Tanzania [11]. In Tanzania, 90% dropout was reported from first ANC visit to PNC visit; while the highest (55%) proportion was seen from institutional delivery to a PNC visit [11].

Maternal and newborn health is continuum of care (CoC) from the life cycle perspective [8]. This perspective of CoC describes delivery of health services from conception through to birth, and childhood- adolescence-adulthood period. The antenatal, intrapartum, and postnatal is a shorter version of CoC. This period is vital for health status of mothers and newborns, and is the combined construct from survival and health service delivery [7]. It is arguably a single entity except for their biological differences; for instance, interventions received by pregnant women can affect health newborns. In the MNH continuum, mid-level health workers can provide essential MNH interventions services up to the first level of health system (peripheral health facilities) and community level. The combined coverage of 4ANC visits,

institutional delivery, and first PNC visit can be considered as the marker of the CoC of MNH [12-14].

Globally, the CoC in MNH has received substantial attention in research, policy and programs over the past two decades [7]. For instance, the sustainable development goal three (SDG3) states universal coverage of quality MNH services across the CoC (target 3.8) [10, 15]. Out of nine tracer services in SDG3, two are related to MNH services, such as childbirth assisted by skilled health attendants and health facility delivery [16]. Thus, the assessment of composite coverage of all routine visits is essential to track the coverage of tracer MNH services and SDG3 target.

Nepal has the highest maternal and neonatal death rates within South Asia [17, 18]. Annually 259 (per 100,000 live births) women die due to pregnancy and childbirth-related issues, and 21 (per 1000 live births) newborn die within the first month of birth in Nepal [19]. High maternal and neonatal deaths in Nepal may be contributed by low coverage of MNH visits, thereby lack of uptake of essential interventions across MNH continuum. Past evidence in Nepal showed poor access to MNH services and poor completion of MNH visits. For instance, Nepal Demographic and Health Survey (NDHS) 2016 reported 70% of pregnant women received 4ANC visits, and nearly two in five women received institutional delivery and first PNC visit within 48 hours of childbirth [19]. A study in 2019 reported only 40% women completed all routine MNH visits, i.e., 4ANC visits, institutional delivery, and PNC visit [8]. The same study reported among rural women, and those with higher birth order (more than two children) had lower odds of MNH visits across the CoC [8]. Another study reported women of wealth status and illiterate women low the completion of MNH visits across the CoC [20]. Other studies revealed that the completion of 4ANC visits contributed to uptake of institutional delivery [21] and PNC visit [22], and women who received institutional delivery services were more likely to receive PNC visit [23-25]. A qualitative exploration of access to PNC observed Nepalese women might only prioritise PNC if they experience complications [26]. However, there is a dearth of evidence on the patterns of (dis)continuity of care at different stages of MNH visits across the MNH CoC and their associated determinants. Thus, this study examined the patterns of inequity of (dis)continuity of all MNH visits and their determinants across the CoC in Nepal.

Methods

Data source and sampling design

The Nepal Demographic and Health Survey (NDHS) 2016 data [19] were used in this study. The NDHS is a nationally representative cross-sectional survey conducted by the MOHP (Nepal) in 2016 to identify the health status and services coverage of primary health care programs, especially family planning, reproductive, newborn, child health and nutrition.

A more detailed sampling design is described in the NDHS 2016 report [19]. Briefly, the NDHS 2016 identified rural and urban sampling strata from seven provinces. The survey adopted a two-stage sampling design. The first stage involved the systematic selection of 383 clusters (primary sampling units) with probability proportional to size from urban and rural strata (14 strata). The second stage consisted of selecting 30 households per cluster through a systematic sampling from a selected household. Of 11, 203 households selected, 11,040 households participated in the survey. Of 13, 089 women aged 15-49 years identified for the interview, 12,862 responded (response rate of 98%). Of them, total 3,998 women had a live birth five years preceding the survey. However, this study restricted to 1,978 women aged 15–49 years who had a live birth in the two years preceding the survey. The NDHS 2016 collected information on pregnancy, childbirth, and postnatal care from women.

Conceptual framework of the study

Based on the review of previous conceptual frameworks [27-29], a conceptual framework was developed for this study (Figure 1). The conceptual framework comprises inputs, outputs, and outcomes. Inputs include different contexts and mechanisms including several determinants, systems, institutional and individuals level factors that can contribute to health outputs, for instance, may produce outputs of (dis)continuity of care and broadly is categorised in three domains: structural, intermediary and health system. Structural domain covers sociopolitical factors (e.g., governance, wealth status, and ethnicity), usually rooted in the distribution of power and resources. Intermediary domain includes factors affecting conditions of heath (non-health sector factors, e.g., geography, transportation, biological and behavioural factors) that affect individual's daily working and living conditions. Structural factors can intermediate non-health sector and can influence the health system variables.

Health system domain includes variables that affect the provision and delivery of quality health services.

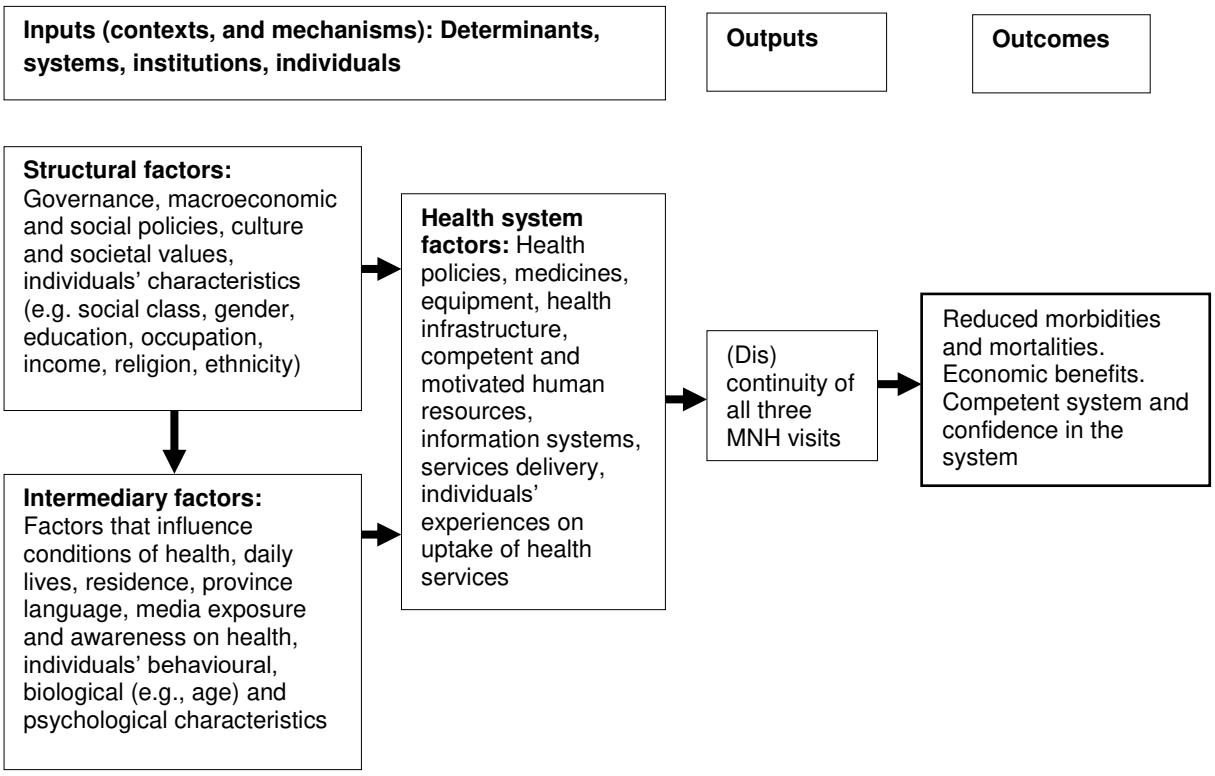

Figure 1 A conceptual framework adapted and modified from WHO's commission of social determinants of health (WHO 2010).

Study variables

Independent variables included the characteristics of women and their health care experiences (Supplementary file, Table 1). As guided by the conceptual framework, independent variables were grouped into three domains: structural, intermediary, and health system. The structural variables included women's ethnicity, wealth status, education, religion, maternal occupation, perceived violence, decision-making for at least one of three areas (healthcare, purchasing, and movement) and sex of household head. Intermediary variables were women's language, maternal age, residence, provinces, region, birth order, sex of child, access to bank account, media exposure, perceived problem of distance to health facilities, and intended birth of the last child. The health system variables included the women's (perceived) problem of not having female health providers, awareness of health mothers' groups, mode of delivery.

Taking reference from past studies [24, 30-32], we further categorised ethnicity, education, wealth status. The Government of Nepal has categorised 123 ethnicities into six broader categories: i) Dalits (untouchable), ii) disadvantaged indigenous, iii) disadvantaged non-Dalit Terai caste groups, iv) religious minorities (Muslims), v) relatively advantaged indigenous, and vi) upper caste groups. These broader categories of ethnicities were merged into two groups according to their comparative privileges: disadvantaged ethnicities (includes Dalit, Muslims, and Terai caste, disadvantaged Janajatis) and advantaged ethnicities (includes Brahmin/Chhetri, advantaged Janajatis). Maternal education was categorised into illiterate (who cannot read and write), and primary (up to grade eight), and secondary and higher (who have education of grade nine or higher). In the NDHS 2016, wealth quintiles were constructed using principal component analysis (PCA) based on more than 40-asset items being owned by households. In this study, these wealth quintiles were merged into two groups, such as the lowest two quintiles as Poor (lower 40%), and upper three quintiles as Rich (upper 60%).

This study had one outcome variable with four mutually exclusive categories: discontinued before completing 4ANC visits=1; completed 4ANC visits but discontinued before completing institutional delivery =2; completed 4ANC visits and institutional delivery but discontinued before completing PNC visit=3; completed all three MNH visits=0 (reference category).

Statistical analysis

Multinomial logistic regression analysis was conducted, and the magnitude of (dis)continuity of care was reported as relative risk ratios (RR) with 95% confidence intervals (CIs). In the analysis, sampling weights (available in the NDHS 2016 dataset) have been calculated and applied, so results are representative at the national as well as strata levels. All analyses were weighted to adjust for the two-staged cluster sampling used in the NDHS 2016 survey (primary sampling unit=383; stratification (strata= 14; province seven with rural and urban; strata); survey weights (probability weight = sample weight/1,000,000) [19]. All estimates were reported in weighted value (unless otherwise indicated) including frequency, and proportion (%). The clustering effect of complex sampling design was adjusted using survey 'svy' set command in Stata 14.0.

Before running the multivariable multinomial regression model, multicollinearity was checked and excluded independent variables having variation inflation factors ≥3 [33]. Backwards elimination multivariable multinomial logistic regression analyses were conducted [34]. First, the full multivariable regression model was run, estimated p-value for each independent variable. Then identified the most insignificant variable was deleted comparing p values. This procedure was repeated until no insignificant independent variable was left at $p<0.2$ [35]. The statistical significance level was set $p<0.05$ (two-tailed) to identify the independent variables associated with the outcome variable. The goodness of fit test was conducted using the Log-likelihood Ratio (LR) test [10]. All analyses were conducted using Stata 14.0 (Stata Corp, 2015).

Results

Background characteristics of women

Table 1 shows the background characteristics of women included in this study. Among the 1,978 women, 42% were from households in the lowest two wealth quintiles. More than two-thirds (69%) of women were from disadvantaged ethnic groups, mostly Madhesi, Janajatis and Dalits. Nearly two in five women (42%) were native Nepali speakers (the national language). Nepali is primarily spoken in the Hill region, where most of the residents are from relatively advantaged ethnicities [36]. Male household head characterised more than two-thirds (73%) of the households.

More than half (55%) of women were from the Terai (Plain) Region. One in four women (26%) were from province two, whereas the smallest percentage of women (6%) were from province six. About half (46%) of women were from urban areas. Two-thirds (67%) of women had no decision-making authority in relation to accessing in health-seeking, buying something (financial decision making in the family) or meeting with relatives (movement). Nearly one-third (29%) of women reported any kind of perceived violence (e.g., beating when food burnt or beating if women went out without asking husband). In total, four in five (79.7%) women were aged 20–34 years, and approximately 69% of women did not have a bank account.

Three in five women felt distance to a health facility was a challenge when accessing health services. Further, nearly 72% of women perceived it as challenging to access care when there was no available female healthcare worker. In addition, over two-thirds (68%) of women had no awareness of the availability of a health mothers'

group in their community. One in ten mothers gave childbirth through caesarean-section.

Table 1: Characteristics of women who had a live birth in the two years preceding the survey in Nepal in NDHS 2016.

Determinants	**Categories**	**Frequency (N=1978) (%)**
Structural		
Wealth status	Lower (40%)	832 (42.0)
	Upper (60%)	1146 (58.0)
Ethnicity	Disadvantaged	1374 (69.5)
	Advantaged	604 (30.5)
Religion	Others	306 (15.5)
	Hindu	1672 (84.5)
Maternal education	No	570 (28.8)
	Primary	391 (19.8)
	Secondary or higher	1016 (51.4)
Maternal occupation	Not working	928 (46.9)
	Agriculture	824 (41.6)
	Working paid	227 (11.5)
Perceived violence	No	1397 (70.6)
	Yes	581 (29.4)
Decision-making authority	No	1324 (66.9)
	Yes	654 (33.0)
Household head	Male	1438 (72.7)
	Female	540 (27.3)
Intermediary		
Languages	Nepali	839 (42.4)
	Maithili	360 (18.2)
	Bhojpuri	267 (13.5)
	Others	512 (25.9)
Residence	Urban	1062 (53.7)
	Rural	916 (46.3)
Province	One	338 (17.1)
	Two	513 (25.9)
	Three	312 (15.8)
	Four	164 (8.3)
	Five	364 (18.4)
	Six	121 (6.1)
	Seven	166 (8.4)
Region	Mountain	131 (6.6)
	Hills	760 (38.4)
	Terai	1087 (55.0)
Maternal age (years)	15-19	291 (14.7)
	20-34	1570 (79.7)
	35+	106 (5.3)

Determinants	Categories	Frequency (N=1978) (%)
Birth order (index child)	<4	1678 (84.8)
	≥4	300 (15.2)
Sex of index child	Male	1063 (53.7)
	Female	915 (46.2)
Access to bank account	No	1367 (69.1)
	Yes	611 (30.9)
Media exposure	No	911 (46.0)
	Yes	1067 (54.0)
Last birth (index child)	Unwanted	418 (21.1)
	Wanted	1560 (78.8)
Distance to health facilities as a perceived problem	No problem	763 (38.6)
	Big problem	1213 (61.4)
Health system		
Perceived problem not having female providers	No problem	562 (28.4)
	Big problem	1416 (71.6)
Awareness on health mothers' group	No	1340 (67.7)
	Yes	638 (32.3)
Mode of delivery	Normal	1780 (90.0)
	Caesarean section	198 (10.0)

(Dis)continuity of care of routine MNH visits in antenatal, intrapartum, and postnatal period

Figure 2 shows the continuity of routine MNH visits across the CoC. Among 1,978 women included in this analysis, only two in five (41%) attended all three MNH visits (4ANC visits, institutional delivery, and one PNC visit within 48 hours of childbirth). Almost all (96%) received at least one ANC visit, but only 71% completed 4ANC visits. More than one in two women (52%) completed at least 4ANC visits and received institutional delivery services. Women without 4ANC visits, however, had a higher rate of home delivery. For instance, among women who were unable to complete 4ANC visits, 58% of them gave birth at home, while 71% of women with no ANC visits (n=72) delivered at home. Only 4% (of N=1,978) of women did not receive any of ANC visits or institutional delivery, or PNC visit (Figure 2).

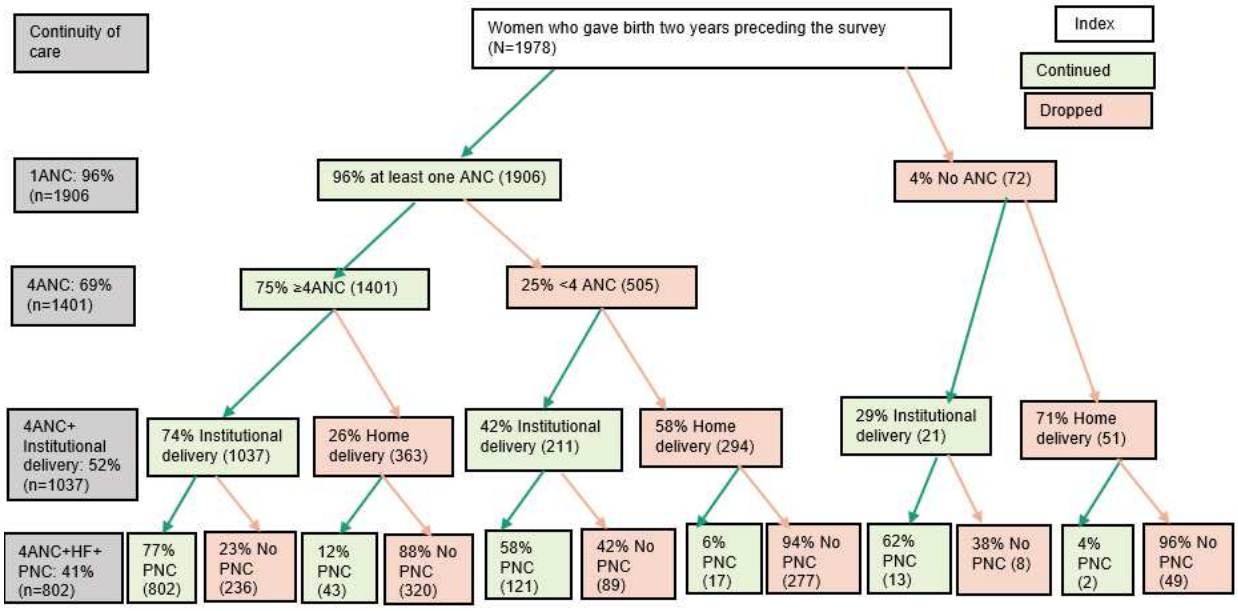

Figure 2: (Dis)continuity of routine MNH visit during the antenatal-postnatal period in Nepal, NDHS 2016. Values in parenthesis indicate the number of women.

Table 2 shows the women who completed/discontinued MNH visits across the CoC. Over half of women completed all visits if they were from provinces three (51%) and four (54%), belonged to advantaged ethnicity (54%), had secondary or higher-level education (54%), had jobs (53%), had a bank account (54%), had media exposure (51%), perceived the distance to the health facility was not a problem (53%) and who delivered via caesarean-section (71%). However, only one in four women completed all three MNH services if they were from province six (24%), a Bhojpuri speaker (21%), illiterate (25%), and higher birth order (≥4) (21%) (Table 2).

Table 2: (Dis)continuity of care of routine MNH visits across the CoC in Nepal, 2016.

Determinants	**Frequency**	**Discontinued before completing 4ANC visits (%)**	**Discontinued before completing institutional delivery (%)**	**Discontinued before completing NC visit (%)**	**Completed all three visits (%)**	**p**
Structural	1,978	29.2	18.4	11.9	40.6	
Wealth status						
Lower (40%)	832	35.1	26.2	8.6	30.0	<0.001
Upper (60%)	1,146	24.8	12.7	14.3	48.2	
Ethnicity						
Disadvantaged	1,374	34.3	19.6	11.3	34.8	<0.001
Advantaged	604	17.6	15.5	13.4	53.6	
Religion						

Determinants	Frequency	Discontinued before completing 4ANC visits (%)	Discontinued before completing institutional delivery (%)	Discontinued before completing NC visit (%)	Completed all three visits (%)	p
Others	306	39.1	16.2	10.1	34.5	0.056
Hindu	1672	27.3	18.8	12.2	41.7	
Maternal education						
Illiterate	570	46.5	20.2	8.8	24.6	<0.001
Primary	391	36.5	24.9	10.0	28.6	
Secondary or more	1,016	16.6	14.8	14.4	54.1	
Maternal occupation						
Not working	928	32.9	13.7	12.9	40.5	<0.001
Agriculture	823	27.6	25.0	10.0	37.3	
Working paid	227	19.2	13.6	14.5	52.7	
Perceived violence						
No	1,397	27.8	18.1	11.2	42.9	0.044
Yes	581	32.4	19.0	13.7	34.9	
Decision-making						
No	1,324	30.9	18.9	11.6	38.6	0.111
Yes	654	25.6	17.3	12.6	44.5	
Household head						
Male	1,438	30.4	18.9	12.2	38.6	0.073
Female	540	25.9	17.0	11.2	45.9	
Intermediary						
Language						
Nepali	839	19.8	17.8	13.2	49.2	<0.001
Maithili	360	32.4	24.5	11.2	32.0	
Bhojpuri	267	54.4	12.1	12.2	21.3	
Others	512	29.1	18.2	10.1	42.6	
Residence						
Urban	1,062	24.5	14.0	13.5	48.0	<0.001
Rural	916	34.6	23.4	10.0	32.0	
Provinces						
One	338	21.2	23.0	8.3	47.5	<0.001
Two	513	42.0	19.2	12.0	26.9	
Three	312	24.2	14.2	10.7	50.9	
Four	164	24.7	11.9	9.0	54.4	
Five	364	25.3	19.5	13.5	41.7	
Six	121	45.4	22.0	9.0	23.6	
Seven	166	16.0	15.5	23.0	45.5	
Region						
Mountain	131	28.3	30.5	3.4	37.8	0.001
Hills	760	23.8	18.2	11.7	46.3	
Terai	1,087	33.0	17.0	13.1	36.9	
Maternal age (years)						
<19	291	25.8	15.7	16.9	41.6	0.146
20-34	1,582	29.2	18.8	11.1	40.9	
≥35	106	37.7	19.7	10.2	32.4	
Birth order						
<4	1,678	24.9	17.7	13.3	44.1	<0.001
≥4	300	52.8	22.3	4.4	20.6	
Sex of index child						
Male	1,063	28.9	17.4	12.1	41.6	0.699
Female	915	29.5	19.5	11.7	39.4	
Access to bank account						
No	1,367	33.9	20.2	11.6	34.4	<0.001
Yes	611	18.6	14.3	12.7	54.4	
Media exposure						
No	911	40.0	22.6	9.5	27.8	<0.001
Yes	1,067	19.9	14.7	13.9	51.4	
Last child (index						

Determinants	Frequency	Discontinued before completing 4ANC visits (%)	Discontinued before completing institutional delivery (%)	Discontinued before completing NC visit (%)	Completed all three visits (%)	p
child)						
Unwanted	418	39.7	16.4	11.1	32.9	<0.001
Wanted	1,560	26.3	18.9	12.1	42.6	
Distance to health facilities as a perceived problem						
No problem	763	23.0	13.6	12.2	51.3	<0.001
Big problem	1,215	33.0	21.4	11.8	33.8	
Health system						
Perceived problem not having female providers						
No problem	562	22.1	14.1	10.7	53.1	<0.001
Big Problem	1,416	31.9	20.1	12.4	35.6	
Awareness of health mothers' group						
No	1,340	32.5	17.7	11.5	38.3	<0.001
Yes	638	22.1	19.8	12.8	45.4	
Mode of delivery						
Normal	1,780	30.6	20.4	11.8	37.2	<0.001
C-section	198	16.1	0	13.0	70.9	

ID: institutional delivery, HF: health facility, HMG: health mothers' group, p-values obtained from Fisher exact test. Other languages include (e.g., Tharu, Magar). Other religions include Buddha, Jain, Kirat, Christian.

Determinants of the (dis)continuity of MNH visits across the continuum of care

Along the pathway of the antenatal-postnatal period, there were three possible points of discontinuation: before completing 4ANC visits, before completing institutional delivery, and/or before completing a PNC visit. In the bivariable regression analysis, several factors were associated with discontinuation along the pathway (Supplementary file; Table 2). Associated structural factors were language, wealth status, education; and intermediary factors significantly associated were the place of residence, province, region, birth order, media exposure on public health issues, access to a bank account, the intention of last birth, perceived problem of the long distance to the health facility, and perceived violence. In addition, health system factors associated significantly with the discontinuity of care were the perceived problem if not having female providers in health facilities, awareness of health mothers' groups, and mode of delivery.

Table 3 shows the multivariate multinomial regression analysis of factors associated with discontinuity of care during the antenatal-postnatal period. Eight determinants were significantly associated with discontinuity of care before completing 4ANC visits. Structural factors, such as illiteracy (Relative Risk Ratio (RR)=2.65; 95% CI: 1.72, 4.08), lower wealth status (RR=2.39; 95% CI: 1.63, 3.51), Bhojpuri language

(RR=3.28; 95% CI: 1.26, 8.58), and living in province six (RR=4.08; 95% CI: 2.30, 7.21) had a higher risk of discontinuity of care before completing 4ANC visits compared to their reference category (completing all MNH visits). Intermediary factors, such as women with higher birth order (≥4) (RR=2.15; 95% CI: 1.41, 3.30), women not having media exposure (RR=1.81; 95% CI: 1.33, 2.46), and unwanted last birth (RR=2.11; 95% CI: 1.47, 3.02) had a higher relative risk of discontinuing before completing 4ANC visits compared to their reference counterparts. Women who had no awareness of the availability of a mothers' group in their community had a higher risk (RR=1.53; 95% CI: 1.13, 2.07) of discontinuing before completing 4ANC visits compared to the reference category.

Nine determinants were significantly associated with continuity of care until 4ANC visits but discontinued before completing institutional delivery (Table 3). Women who had primary education (RR=1.92; 95% CI:1.26, 2.93) and lower wealth status (RR=2.82; 95% CI:1.88, 4.22), who were involved in agriculture (RR=1.51; 95% CI:1.04, 2.19) or from disadvantaged ethnicity (RR=1.54; 95% CI:1.05, 2.26) had a higher relative risk of discontinuity of care before completing institutional delivery (compared to the continuity of care of all MNH visits) compared to women with secondary or higher education, higher wealth status, women who had paid jobs, and women of advantaged ethnicities, respectively. Moreover, women who lived in rural areas (RR=1.91; 95% CI: 1.36, 2.69) had a higher risk of discontinuity of care before completing institutional delivery compared to women from urban areas. Additionally, women with no media exposure (e.g. radio, newspaper, television) (RR=1.56; 95% CI: 1.13, 2.14) had a higher risk of continuity of 4ANC visits. However, women from province four (RR=0.47; 95% CI: 0.23, 0.94) and those aged 15–19 years (RR=0.63; 95% CI: 0.39, 0.99) had significantly associated with a lower risk of discontinuation before completing institutional delivery (compared to completion of all three MNH visits) compared to women from province one and those aged 20–34 years.

Two determinants were associated with continuity of care until 4ANC visits and institutional delivery but discontinued before completing PNC visits (Table 3). Women from provinces six (RR=2.24; 95% CI: 1.07, 4.71) and seven (RR=3.57; 95% CI: 1.87, 6.81), and women with a perceived problem of not having a female provider (RR=1.64; 95% CI: 1.12, 2.39) had a higher risk of completing all 4ANC visits and

1 institutional delivery compared to their respective reference category (completion of
2 all routine MNH visits).

1 Table 3: Multivariale multinomial logistic regression of determinants of continuity of routine MNH visits in Nepal, NDHS 2016 (N=1,978)

Determinants	Discontinued before completing 4ANC visits (ARR; 95% CI)	Discontinued before completing institutional delivery (ARR; 95% CI)	Discontinued before completing PNC visit (ARR;95% CI)
Structural			
Wealth status			
Upper (60%)	1.00	1.00	1.00
Lower (40%)	2.39 (1.63, 3.51) ***	2.82 (1.88, 4.22) ***	0.93 (0.59, 1.48)
Ethnicity			
Advantaged	1.00	1.00	1.00
Disadvantaged	1.47 (0.79, 2.71)	1.54 (1.05, 2.26) *	1.28 (0.82, 1.98)
Maternal occupation			
Agriculture	0.79 (0.56, 1.11)	1.51 (1.04, 2.19) *	0.87 (0.59, 1.29)
Housewife	1.00	1.00	1.00
Working paid	0.64 (0.35, 1.15)	1.22 (0.70, 2.13)	1.08 (0.62, 1.90)
Maternal education			
Higher	1.00	1.00	1.00
Illiterate	2.65 (1.72, 4.08) ***	1.39 (0.93, 2.08)	1.21 (0.72, 2.02)
Primary	2.41 (1.62, 3.57) ***	1.92 (1.26, 2.93) **	1.20 (0.74, 1.93)
Intermediary			
Language			
Nepali	1.00	1.00	1.00
Maithili	1.31 (0.57, 3.00)	1.36 (0.6, 3.11)	0.71 (0.29, 1.77)
Bhojpuri	3.28 (1.26, 8.58) *	0.97 (0.35, 2.68)	1.06 (0.44, 2.57)
Others	1.52 (0.81, 2.84)	0.89 (0.55, 1.42)	0.66 (0.41, 1.05)
Province			
One	1.00	1.00	1.00
Two	1.73 (0.93, 3.21)	1.34 (0.67, 2.71)	2.19 (0.89, 5.42)
Three	1.31 (0.68, 2.54)	0.75 (0.41, 1.35)	1.14 (0.57, 2.27)
Four	1.45 (0.79, 2.68)	0.47 (0.23, 0.94) *	0.95 (0.46, 1.97)
Five	1.10 (0.61, 1.96)	1.09 (0.67, 1.76)	1.93 (0.98, 3.82)
Six	4.08 (2.30, 7.21) ***	1.32 (0.65, 2.68)	2.24 (1.07, 4.71) *
Seven	0.56 (0.29, 1.07)	0.51 (0.25, 1.02)	3.57 (1.87, 6.81) ***
Residence			
Urban	1.00	1.00	1.00

Determinants	Discontinued before completing 4ANC visits (ARR; 95% CI)	Discontinued before completing institutional delivery (ARR; 95% CI)	Discontinued before completing PNC visit (ARR;95% CI)
Rural	1.35 (0.95, 1.93)	1.91 (1.36, 2.69) ***	0.97 (0.64, 1.48)
Maternal age (in years)			
15-19	0.79 (0.52, 1.20)	0.63 (0.39, 0.99) *	1.24 (0.78, 1.95)
20-34	1.00	1.00	1.00
35 or above	0.55 (0.29, 1.04)	0.79 (0.35, 1.78)	1.66 (0.67, 4.11)
Birth order			
<4	1.00	1.00	1.00
≥4	2.15 (1.41, 3.30) ***	1.5 (0.98, 2.30)	0.52 (0.26, 1.06)
Media exposure			
Yes	1.00	1.00	1.00
No	1.81 (1.33, 2.46) ***	1.56 (1.13, 2.14) **	1.01 (0.69, 1.50)
Last birth (index child)			
Wanted	1.00	1.00	1.00
Unwanted	2.11 (1.47, 3.02) ***	1.15 (0.76, 1.72)	1.10 (0.67, 1.82)
Health system			
Perceived problem not having female providers			
No problem	1.00	1.00	1.00
Big problem	1.25 (0.89, 1.76)	1.46 (1.05, 2.04) *	1.64 (1.12, 2.39) *
Awareness on health mothers' group			
Yes	1.00	1.00	1.00
No	1.53 (1.13, 2.07) **	1.10 (0.79, 1.53)	1.06 (0.76, 1.46)

*** p<0.001, ** p<0.01, * p<0.05. Determinants that had p<0.2 included in the final model adjusting for covariates listed in the table. The likelihood ratio of the reduced model with the full model was [chi-square=19.47; p=0. 0.555], and our model was the best fit. HWs: health workers, HMG: health mothers' group, HF: health facility, ANC: antenatal care. The reference category of outcome variable was the completion of all three MNH visits. Other languages include Tharu, Magar. ARR: Adjusted risk ratio.

Discussion

The current study examined the composite of coverage routine MNH visits and had low completion of all routine MNH visits across the CoC. We found more than two-in-five (41%) women in Nepal received all routine MNH visits across the CoC. There was high proportion of discontinuation around later weeks of pregnancy (4ANC visits) or around childbirth (institutional delivery). Several structural determinants were found to be associated with discontinuity of care across the CoC. For instance, women with structural disadvantages (e.g., disadvantaged ethnicity, women of lower wealth status, illiterate women) had a higher risk of discontinuation across the CoC. Intermediary and health system determinants contributed to the (dis)continuity of care of MNH services (e.g., provinces six or seven, Maithali speaker women, high birth order, and poor media exposure on health issues); if women had poor awareness on health mothers' group, and perceived problem if not having female providers in health facility found to have higher risk of discontinuation of MNH visits across the CoC.

The reasons for low CoC in this study may be due to high discontinuation around later gestational week of childbirth, and no PNC visit of women gave birth in health facilities. Women delivering in health facilities should receive at least one PNC visit within 48 hours (at least at the time of discharge from health facilities after childbirth), but the lower PNC visit compared to institutional delivery, suggests not all women/newborns received PNC visit even where delivery took place in a healthcare facility. The lower completion of all routine MNH visits was consistent with the studies in Cambodia [37] and Lao PDR [38]. Other studies have reported poor uptake of 4ANC visits and institutional delivery due to long waking hours, and unavailability of necessary arrangements in local health facilities [39, 40]. In later weeks prior to childbirth or around childbirth, pregnant women may face difficulties to reach healthcare facilities if physical access is poor, or there is no suitable accommodation close to the health facility [42]. A study in Nepal also indicated that despite the accessibility of healthcare facilities, knowledge of and demand for PNC was low [43]. The accrediting health posts to birthing centers and strengthening existing birthing could increase the availability of intrapartum care in rural health facilities. On the other hand, ensuring necessary arrangement to reach health

facilities could increase institutional delivery and first PNC visit within 48 hours of childbirth. In the interim, the provision of trained community health workers could increase the utilisation of PNC.

The current study revealed women with social disadvantages (illiterate, poor, marginalised ethnic group, involved in agricultural work) and geographical factors had higher discontinuation across the CoC. Other studies have reported women's living, and working life [40] also influences the uptake of maternity services [44], and women with poor wealth status have poor MNH coverage during pregnancy and childbirth [44]. Such women may not seek health services unless there are complications. In addition, women with social disadvantages experience difficulties in daily life, usually have more focus on livelihood support than healthcare; they have inequitable distribution of livelihood opportunities and resources that contribute to poor access to and higher discontinuation of routine MNH visits. These factors are mostly non-modifiable and often require long term sociopolitical interventions [45-48], and technical and biomedical focussed approaches on their own may not improve MNH visits across the CoC [47]. Longer-term structural interventions to improve MNH CoC may include improving female access to formal and informal education and employment opportunities [45].

Health system factors could improve the continuity of care of MNH visits across the CoC, for instance, birth spacing, awareness on health issues through mass media exposure and having female providers at the health facility. In the current study, women who have already more than four children, or if last birth intended, such women discontinued the MNH visits in the last birth. This suggests if women had intended pregnancy, they could get priority for needed MNH visits. Effective uptake of family planning services could help for wanted pregnancy and reduced birth spacing, resulting in women could complete all MNH visits for their intended birth [45].

Health awareness on the importance of pregnancy, childbirth, and PNC services can be improved via exposure to mass media (e.g., local radios, television) and dissemination of health information to current and future mothers. A past study in Nepal reported mass media exposure was positively associated with maternal

healthcare utilisation [49]. Health awareness through mobile technology could play an important role in the utilisation of health services generally [50] and the MNH services particularly [51]. Context-specific strategies can be adopted to increase the uptake of needed MNH visits that include outreach clinics in remote and underprivileged communities, or mobilisation of local community workers for PNC home visits [52]. In addition, properly functional health mothers' group in the community could raise awareness among pregnant women and provide necessary health information in their pregnancy and childbirth. Health mothers' groups are women-led community health groups where current and future mothers can gather and discuss reproductive, maternal, child health and nutrition issues [53]. Such health groups could address the social taboos as talking about reproductive health-related issues is culturally taboo in Nepali society, and women are usually like to share the provision of female providers [26, 54]. Additionally, the current SDIP has provisioned 4ANC visits and institutional delivery, but the provision of financial incentive lacks for PNC visit. Ensuring financial incentive in the SDIP programs could increase the uptake of all three MNH visits.

The measurement of continuity of care is important for tracking health services coverage across the MNH continuum essential by creating a composite coverage indicator of all three routine MNH visits. Such measurement and tracking could give the actual coverage of MNH visits across the CoC. Past studies [55, 56] and routine monitoring system [57] lack measurement of composite coverage of all routine MNH visits across the CoC. The completion of all MNH visits is a critical window of opportunity to receive recommended MNH interventions for the survival of mothers and newborns. A modelling study estimated that increased access and quality of MNH interventions across the CoC could avert up to 71% and 54% neonatal and maternal deaths respectively, and 33% of stillbirths annually [5]. The composite coverage measurement of MNH visits can have a significant implication in countries with high maternal and neonatal deaths.

Policy and programmatic implications

This study has some implications for programs and research. First, the creation and execution of a composite indicator provided insight into MNH CoC and should be included in routine health management information system (HMIS) and periodic

health survey (e.g., demographic and health survey). The quality of MNH services is prioritised in SDG3, which focuses on universal coverage of MNH services [58]. Universal coverage of quality MNH services is crucial for better MNH outcomes and in achieving SDG3. The government of Nepal should focus its programs targeting women living in difficult geographical areas (e.g., province six) and women with social disadvantages (e.g., poor, marginalised ethnicity). Supply-side approaches found to improve the better health services delivery included strengthening birthing center (e.g., health logistics, human resources and training), and establishing maternity waiting home [59]. Availability of childbirth services in all rural health facilities could increase the facility childbirth and first PNC visit. The home visits through community health workers in hard to reach community could also improve PNC visit home visit.

Second, the provision of female health providers could improve the counselling on the importance of MNH services in the MNH continuum. Other potential strategies could be mass media mobilisation to raise awareness on the COC and focused MNH services to disadvantaged population groups, such as women of lower wealth status, who speak Maithali speak, living in remote areas. The health system could formulate focussed service delivery packages to women with structural disadvantages, for instance, provision of focus incentive to those groups who are most marginalised women, Dalits, Karnali province, Maithali speaking women. The current safe delivery incentive program (SDIP) includes separate incentives for 4ANC visits, and institutional delivery program [60]. This SDIP should be reformed by providing incentive for women those who complete 4ANC visits, delivered babies in health facilities and complete first PNC visit. Additionally, such incentive program needs to be designed for specific groups based on marginalisation status. The composite coverage indicator employed in this study could help to reform the SDIP.

Third, health services need to focus on remote areas, including improving family planning services. Better family planning services could improve the birth spacing, thereby reducing unintended pregnancy and reduced numbers of parity. Women of wanted pregnancy may complete all routine MNH visits and receive all essential antenatal, intrapartum, and postnatal interventions for their and newborns better health.

Strengths and limitations of the study

This study has some strengths and limitations. Strengths included; first, this study is based on a nationally representative survey with higher response rate (98%), and findings could be generalised at the national level. Second, this study considered the PNC visit for mothers and newborns rather than previous studies that examined PNC visit for newborn or PNC mothers separately. This study has the following limitations. First, inferences drawn from this study are based on an observational and cross-sectional design, which allows the study of correlations rather than causality. Second, the NDHS 2016 collected information based on recall of women who had a live birth five years prior to the survey (2011-2016); however, we included a short recall period of two years restricting study sample of women who had a live birth two years preceding the survey (2014–2016). Third, this study is based on secondary data analysis; we were unable to include important variable such as obstetric complications that could contribute to discontinuation along the pathway. Fourth, the outcome variable was self-reported after face-to-face interviews with women, which may have social desirability bias (e.g., over-reporting of good behaviours and underreporting of bad behaviours) and misclassification. Finally, from the research perspective, this study has not explored stories of why women discontinued health services utilisation across the CoC. The qualitative study could provide a deeper understanding of real stories of the underlying reasons for discontinuation across the CoC.

Conclusions

Only two-in-five women completed all MNH visits across the CoC. Disadvantaged women had high discontinuation in different stages of CoC. Creation and execution of composite coverage of 4ANC visits, institutional delivery and PNC visits could track the uptake of health services across the CoC. Monitoring of health services utilisation using composite coverage indicator and provision of focused strategies (e.g., home visits and outreach services, incentive who complete all MNH visits) could increase the completion of all MNH visits across the CoC, especially among disadvantaged women. The provision of continuous availability of MNH services in health facilities, trained female health services providers, and provision of quality health care could improve the continuity of care during pregnancy, intrapartum, and

the postnatal period.

Supplementary file

Table 1: Description of variables included in the analysis of (dis)continuity of care of routine MNH visits in Nepal, 2016

Table 2: Bivariable multinomial logistic regression analysis

Abbreviations

ANC: Antenatal Care; CoC: Continuum of care; LMICs: Low and lower-middle-income countries; MNH: Maternal and newborn health; NDHS: Nepal Demographic and Health Survey; PNC: Postnatal Care; SDIP: Safe Delivery Incentive Program

Declaration

Ethics approval and consent to participate

We used secondary data from the NDHS 2016. The NDHS 2016 was approved by an ethical review board of Nepal Health Research Council, Nepal, and ICF Marco International, Maryland, USA. The Ministry of Health and Population (MOHP) (Nepal), ICF International Maryland, and DHS program (USA) approved and oversaw the overall research process of the NDHS 2016. The NDHS data are publicly available for further analysis, and data were deidentified of the research participants. This study did not require ethical approval from respective institutions. However, the first author took approval for the download and use of dataset for his doctoral thesis, downloaded data of individual women record from the Nepal data file available from the DHS program (https://dhsprogram.com/data/available-datasets.cfm).

Consent for publication

Not applicable

Availability of data and materials

Data used in this study are publicly available secondary data obtained from the DHS (https://dhsprogram.com/data/available-datasets.cfm) program.

Competing interests

The authors declared that they have no competing interests.

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Authors' contributions

RBK conceived of the study, performed the statistical analysis. RBK and JD drafted the manuscript. RK, JD and YA supervised the study. All authors contributed significantly during the revision and finalised the manuscript. All authors read and agreed on the final version of the manuscript.

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1 **Supplementary file**

2 Table 1 Description of variables included in the analysis of (dis)continuity of care of routine MNH services in Nepal, 2016

Variables	Categories	Descriptions
Independent		
Structural		
Wealth status	Lower wealth status (lower 40%); Upper wealth status (upper 60%)	NDHS data had a variable wealth quintile, which was calculated based on scores generated from principal components analysis of households' assets (40 items). It was grouped into two categories: lower (poorest, poor, or collectively called as lower two quintiles); and upper (middle, richer, and richest or collectively called as upper three quintiles) wealth status.
Ethnicity	Disadvantaged; Advantaged	Disadvantaged: Dalit, Muslims, and Terai caste, Janajatis disadvantaged) and advantaged: Brahmin/Chhetri, advantaged Janajatis).
Maternal education	Illiterate; Primary; Secondary or higher	Illiterate: Cannot read and write; Primary: 1-8 grade. Secondary or higher: 9th grade and higher
Religion	Others; Hindu	Others include Muslims, Jain, Christian, Buddhist
Maternal occupation	Not working (housewife); Agriculture; Working paid	Based on the response of respondents, not working women are housewives (usually husbands of such women have paid jobs), agriculture (family's main source of income is agriculture), and paid job
Perceived violence	No; Yes	Yes: if women perceived beating in any one of the following conditions: the wife goes out without telling the husband, wife neglects the children, wife argues with husband, wife refuses to have sex with husband; wife burns the food. Otherwise no perceived violence
Household head	Male; Female	This is the decision-maker in the family, as an indicator of women's empowerment
Decision-making authority	No; Yes	Whether women participated in at least one of the decisions regarding their health care, purchases or visits to their family or relatives' households
Intermediary		
Languages	Nepali, Maithili, Bhojpuri, and Others (e.g. Tharu, Newari)	The primary language of the respondents
Maternal age (in years)	15-19, 20-34, 35 and above	15-19, and 35+ years are more at-risk groups
Residence	Urban; Rural	Municipalities are called urban, and remaining parts are called rural areas. This rural-urbancategorizationis based on socioeconomic indicators of the population. Municipalities have a higher populationand developmentindicators. However, many municipalities which are considered as urban areas do not have adequate development facilities
Province	1-7 provinces	Now, provinces are numbered (has not been named)
Region	Mountain; Hills; Terai	Ecological region
Birth order	Less than 4; 4 or more	Numbers of children in the family.

Variables	Categories	Descriptions
Sex of index child	Male; Female	Sex of last birth child
Access to bank account	No; Yes	This is a marker of financial empowerment and access to financial resources
Media exposure	No; Yes	Received health related message from at least one of the following once a week: newspaper, radio, or television
Last birth (index child)	Unwanted; Wanted	Women perceived the youngest child intentional or not
Distance to health facilities is a perceived problem	No problem; a big problem	Perception of problem associated with distance to HF for medical care
Health system		
Perceived problem not having female providers	No problem, big problem	Perceived problem, or not; if no female health provider for healthcare service delivery
Awareness on health mothers' group	No; Yes	Awareness of health mothers' groups in the respective wards
Mode of delivery	Normal; C-section	Types of childbirth services received by women at health facility
Outcome variable		
(Dis)continuity of care	Discontinuation before completing 4ANC visits, discontinuation before completing institutional delivery, discontinuation of before completing PNC visit; completion of all three visits	(Dis)continuity of care from the antenatal- postnatal period

Table 2: Bivariable multinomial logistic regression analysis

Determinants	Categories	Unadjusted multinomial logistic regression analysis		
		Completed <4ANC visits (vs all three visits) Crude RR (95% CI)	Completed ≥4ANC visits (vs all three visits) Crude RR (95% CI)	Completed ≥4ANC visits and institutional delivery (vs all three visits) Crude RR (95% CI)
Structural				
Wealth rank	Upper	1.00	1.00	1.00
	Lower (60%)	2.27(1.69, 3.07) ***	3.33(2.39,4.63) ***	0.97(0.66, 1.42)
Ethnicity	Advantaged	1.00	1.00	1.00
	Disadvantaged	3.01(2.08, 4.35) ***	1.96(1.40, 2.73) ***	1.30(0.92, 1.83)
Religion	Other	1.00	1.00	1.00
	Hindu	0.58(0.38, 0.89) *	0.96(0.61, 1.51)	1.00 (0.59, 1.68)
Maternal occupation	Agriculture	1.00	1.00	1.00
	Housewife	1.10(0.83, 1.45)	0.50(0.37, 0.68) ***	1.19(0.80, 1.76)
	Working paid	0.49(0.30, 0.80) **	0.38(0.23, 0.64) ***	1.02(0.58, 1.79)

Determinants	Categories	Unadjusted multinomial logistic regression analysis		
		Completed <4ANC visits (vs all three visits) Crude RR (95% CI)	Completed ≥4ANC visits (vs all three visits) Crude RR (95% CI)	Completed ≥4ANC visits and institutional delivery (vs all three visits) Crude RR (95% CI)
Maternal education	Higher	1.00	1.00	1.00
	Illiterate	6.16 (4.38, 8.65) ***	3.00(2.11, 4.25) ***	1.34(0.86, 2.08)
	Primary	4.15 (2.94, 5.87) ***	3.18(2.17, 4.67) ***	1.32(0.83, 2.08)
Perceived violence	No	1.00	1.00	1.00
	Yes	1.43(1.07, 1.91) *	1.28(0.92, 1.79)	1.51(1.06, 2.15) *
Decision making	Yes	1.00	1.00	1.00
	No	1.39(1.06, 1.83) *	1.26(0.89, 1.80)	1.06(0.76, 1.49)
Household head	Male	1.00	1.00	1.00
	Female	0.72 (0.55, 0.93) *	0.76(0.55, 1.04)	0.77(0.52, 1.15)
Intermediary				
Language	Nepali	1.00	1.00	1.00
	Maithili	2.52(1.61, 3.96) ***	2.11(1.29, 3.43) **	1.30(0.81, 2.08)
	Bhojpuri	6.36(3.84, 10.55) ***	1.57(0.81, 3.05)	2.13(1.06, 4.26) *
	Others	1.70 (1.16, 2.49) **	1.18(0.80, 1.72)	0.89(0.60, 1.31)
Province	One	1.00	1.00	1.00
	Two	3.50(2.09, 5.84) ***	1.47(0.84, 2.59)	2.56(1.32, 4.96) **
	Three	1.07(0.56, 2.02)	0.58(0.29, 1.15)	1.20(0.61, 2.36)
	Four	1.02(0.57 ,1.81)	0.45(0.22, 0.90) *	0.95(0.46, 1.96)
	Five	1.36(0.73, 2.52)	0.97(0.59, 1.60)	1.86(0.97, 3.58)
	Six	4.30(2.55, 7.25) ***	1.93(1.04, 3.58) *	2.19(1.07, 4.47) *
	Seven	0.79(0.47, 1.32)	0.70(0.37, 1.33)	2.89(1.51, 5.54) **
Region	Hill	1.00	1.00	1.00
	Mountain	1.46(0.72, 2.97)	2.05(1.04, 4.02) *	0.35(0.11, 1.10)
	Terai	1.74(1.22, 2.48) **	1.17(0.82, 1.66)	1.40(0.98, 2.00)
Residence	Urban	1.00	1.00	1.00
	Rural	2.12 (1.48 ,3.04) ***	2.51(1.76,3.59) ***	1.12(0.77,1.61)
Maternal age (in years)	15-19	1.00	1.00	1.00
	20-34	1.15(0.76, 1.74)	1.22(0.80, 1.86)	0.67(0.44, 1.01)
	35 above	1.88(0.96, 3.66)	1.62(0.69, 3.80)	0.78(0.32, 1.91)
Birth order	<4	1.00	1.00	1.00
	≥4	4.54(3.09, 6.68) ***	2.70(1.88, 3.89) ***	0.71(0.38, 1.34)
Sex of index child	Male	1.00	1.00	1.00
	Female	1.08(0.85, 1.37)	1.18(0.88, 1.58)	1.02(0.75, 1.38)
Access to bank account	Yes	1.00	1.00	1.00
	No	2.89(2.02, 4.14) ***	2.23(1.62, 3.07) ***	1.44(1.01, 2.06) *
Media exposure	Yes	1.00	1.00	1.00
	No	3.72 (2.85, 4.85) ***	2.83(2.12, 3.79) ***	1.27(0.90, 1.78)
Last birth (index child)	Wanted			
	Unwanted	1.95(1.38, 2.76) ***	1.12(0.76, 1.66)	1.18(0.75, 1.87)
Distance to health facilities was a perceived problem	No problem	1.00	1.00	1.00
	Big problem	2.17(1.64, 2.89) ***	2.39(1.75, 3.25) ***	1.47(1.03, 2.08) *

Determinants	Categories	Unadjusted multinomial logistic regression analysis		
		Completed <4ANC visits (vs all three visits) Crude RR (95% CI)	**Completed ≥4ANC visits (vs all three visits) Crude RR (95% CI)**	**Completed ≥4ANC visits and institutional delivery (vs all three visits) Crude RR (95% CI)**
Health system				
Perceived problem not having female providers	No problem	1.00	1.00	1.00
	Big problem	2.16(1.56, 2.99) ***	2.13(1.50, 3.02) ***	1.74(1.23, 2.46) **
Awareness on health mothers' group	Yes	1.00	1.00	1.00
	No	1.75(1.36, 2.25) ***	1.06(0.79, 1.41)	1.07(0.77, 1.48)
Mode of delivery	C-section	1.00		1.00
	Normal	3.62(2.04, 6.45) ***		1.73(1.06, 2.84) *

1