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Patterns and determinants of effective coverage of routine maternal and newborn health visits in Nepal: Analysis of the 2016 Demographic and Health Survey

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Abstract

Background

Antenatal care (ANC) visits, institutional delivery, and postnatal care (PNC) visits are vital for improved health of mothers and newborns. Access of these routine maternal and newborn health (MNH) visits have increased in the last few decades in Nepal; however, little is known on the effective uptake (including timely, skilled, frequent, and adequate care) of essential MNH interventions during those visits. This study examined the patterns of effective coverage (EC) of routine MNH visits and their determinants in Nepal.

Methods

A secondary analysis was conducted taking data from the Nepal Demographic and Health Survey (NDHS) 2016. The study included 1,978 women aged 15–49 years who had a live birth in the two years preceding the survey. Three outcome variables were EC of i) at least 4ANC visits, ii) institutional delivery, and iii) first PNC visit for newborns and mothers within 48 hours of childbirth. The independent variables included several structural, intermediary and health system factors. Binomial logistic regression analysis was conducted, and the magnitude of EC was reported as odds ratio (OR) with 95% confidence intervals (CIs). The statistical significance level was set at $p < 0.05$ (two-tailed).

Results

The effective coverage of 4ANC visits, institutional delivery, and PNC visit was 52%, 33% and 23%, respectively. Women with advantaged ethnicity were more likely and women living in province six, who speak the Maithili language, who had high birth order (≥ 4) were less likely to have good EC of MNH visits compared to their reference categories. Women who had access to a bank account, completed at least 4ANC visits or had caesarian-section delivery were more likely to have good EC of MNH visits. Women who perceived problem if not seen by female providers had poor EC of MNH visits compared to their reference counterpart.

Conclusions

Women with ethnic and social disadvantages and remote areas had poor EC of MNH visits. Continuous monitoring of EC of MNH visits is vital, especially among women with markers of disadvantages. Policies and programs should focus on increasing the uptake of essential MNH interventions, especially among women with social disadvantages and those living in remote areas.

68 **Keywords:** Effective coverage, health facility, maternal and newborn health,
69 determinants, Nepal

70 **Introduction**

71 Globally, maternal and neonatal mortality have declined over the last few decades;
72 however, most of these deaths are concentrated in the low- and lower-middle-
73 income (LMICs) countries within Sub-Saharan Africa and South and South-East Asia
74 [1]. Most maternal and newborn deaths can be prevented by improved access to and
75 quality of essential antenatal, intrapartum, and postnatal interventions. According to
76 the World Health Organization (WHO), every pregnant woman (and newborn) should
77 receive these essential interventions [2, 3]. During pregnancy, women should receive
78 at least four antenatal care (ANC) visits encompassing antenatal interventions (e.g.,
79 iron supplementation, tetanus toxoid immunisation) and be screened for high-risk
80 pregnancy [4]. Intrapartum interventions include childbirth assisted by skilled birth
81 attendants; women and newborn should receive intrapartum and immediate newborn
82 care interventions [5]. Postnatal interventions cover the examination of mother and
83 their babies for any infections, advice for hygiene and sanitation, advice for nutrition
84 and family planning during the first week of childbirth [6]. Every woman (and
85 newborns) should complete at least three postnatal care (PNC) visits within the first
86 week of childbirth [7]. The composite coverage of those technical interventions and
87 procedures can be described as the effective coverage (EC) of health services [8].
88 The EC of health services account for multiple dimensions of quality of health care,
89 including frequency and adequacy of services provided by skilled health workers [9],
90 and service uptakes (of essential interventions) at HFs [3, 10].

91 Despite increased access to routine maternal and newborn (MNH) visits in many
92 LMICs [11, 12], the reduction of the Maternal Mortality Ratio (MMR) and the
93 Neonatal Mortality Rate (NMR) is slow [13]. Poor uptake of essential interventions
94 during routine MNH visits have contributed to the stagnant or slow rate of reduction
95 of NMR and MMR [3]. Only reaching at HFs, however, does not guarantee that
96 women receive all the recommended interventions [14]. Programs and research
97 need to also examine the actual receipt of essential MNH interventions and patterns
98 and determinants of EC of health services including MNH services [15, 16].

Measuring EC requires information about what happens at HF after visits, and can provide insights into the quality of health services [17, 18]. Estimation of EC incorporates the population in need of health services, the proportion of HFs contact for services, and the composite coverage of uptake of essential MNH interventions at the HFs and reflects the performance of health systems [2, 19]. The EC of health services, therefore, provides a proxy measure of the quality of health services [20, 21] and is being given a high priority in policies and programs, especially in reproductive, maternal and child health programs [8, 22, 23].

Nepal has a high MMR (259 per 100,000 live births) and NMR (21 per 1000 live births) within South Asia [24]. Further, while significant progress has been made, the rate of reduction has slowed substantially compared to the rates of increases in MNH visits over the past two decades in Nepal. For instance, from 2006 to 2016, institutional delivery increased from 18% to 59%, while MMR decreased from 281 to 259 in the same period [25]. Evidence suggests that high death rates among disadvantaged groups who usually have low coverage of routine MNH visits [25]. The slow progress in women and newborns' survival can be explained by either disadvantaged women having poor access to recommended MNH interventions or the health system is inefficient in providing essential MNH interventions.

In the current health policy document, Nepal has prioritised quality of care as the health system's overarching principle, within the Nepal health sector strategy (NHSS) (2015-2020) [26], the national health policy 2019 [27] and the Nepal Safe Motherhood and Newborn Health Roadmap 2030 [28] emphasizing the universal quality of health services for achieving Sustainable Development Goal 3(SDG3), including MNH services [29]. The current system, however, lacks a healthcare quality monitoring mechanism. Neither the routine health information system such as health management information system (HMIS) [30] nor do any strategic documents describe the measurement of EC of health services, including for MNH [31, 32]. While studies have examined contact coverage of routine MNH visits [33, 34] and perceived quality of care [35, 36], little is known evidence is published in the EC of routine MNH visits [37]. This study examined about the patterns and determinants of EC of routine MNH visits. This study begins to address this gap findings and may inform programs and policies to target women groups with a high burden of maternal

and newborn mortalities but with poor access to quality MNH services in Nepal and similar settings.

Methods

Data sources and sampling design

The NDHS 2016 data were used for this study, extracted data of individual women record from the NDHS. The NDHS 2016 is a nationally representative cross-sectional survey conducted to assess the health services performance, especially health status of reproductive, newborn, child health and nutrition [25].

A more detailed sampling method is described in the NDHS 2016 report [25]. In brief, the NDHS 2016 identified rural and urban sampling strata from seven provinces producing 14 strata. The survey adopted a two-stage sampling design. The first stage involved a systematic selection of 383 clusters with probability proportional to size from urban and rural strata. The second stage consisted of selecting 30 households per cluster through a systematic sampling from a selected household. Of selected 11,203 households but 11,040 responded to the survey. From those households, of 13,089 women age 15-49 years identified for interviews, 12,862 responded (response rate of 98%). Among them, 3,998 women had a live birth five years preceding the survey. This study included 1,978 women aged 15–49 years who had a live birth in the two years preceding the survey as this sample included information on pregnancy, childbirth, and postnatal care interventions.

Conceptual framework of the study

Based on the review of previous conceptual frameworks [38-40], a conceptual framework was developed for this study (Figure 1). This conceptual framework comprises inputs that include several determinants, their contexts and mechanisms at system, institutional and individual level. These contexts and mechanisms can produce the output of effective uptake of MNH interventions. Improved output as EC of MNH visits may lead to the survival of mothers and newborns, economic benefit, and confidence in the system. Inputs are broadly categorised into three domains: structural, intermediary, and health system. Structural factors cover all basic factors (e.g., wealth status, ethnicity, gender) that can influence the intermediary and health system factors. Intermediary factors are non-health sector factors, which generally

affect the conditions of health via influencing the family/community contexts (living and working conditions) and individual characteristics. Health system variables include several variables that involve in the provision and delivery of quality health services.

Figure 1 A conceptual framework adapted and modified from the WHO's Commission on Social Determinants of Health [41].

Study variables

Independent variables included characteristics of women and their healthcare experience (Supplementary Table S1). Based on available information in the NDHS 2016 data, and as guided by the conceptual framework (Figure 1). The variables under the structural domain were 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. In addition, independent variables under the intermediary domain were the age of mothers, first language, residence, provinces, region, birth order, sex of the child, access to a bank account, media exposure, distance to health facilities as perceived

problem, and intended birth of the last child. Health system factors included the (perceived) problem of not having female healthcare providers, awareness of health mothers' groups, mode of delivery, and EC of 4ANC visits, and EC of institutional delivery.

Taking reference from past studies [33, 34, 42, 43], ethnicity, education, wealth status were further defined for this study. 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 ethnic groups were merged into two groups according to their comparative privileges: disadvantaged ethnicities (includes Dalit, Muslims, and non-Dalit Terai caste, disadvantaged Janajatis) and advantaged ethnicities (includes Brahmin or Chhetri, advantaged Janajatis). Maternal education was categorised as illiterate (who cannot read and write), and primary (who can read and write and up to grade 8), and secondary and higher (who have grade 8 and higher-level education). In the NDHS 2016, wealth quintiles were constructed using principal component analysis (PCA) based on more than 40-asset items being owned by households. The lowest two quintiles were merged as lower wealth status (lower 40%), and the upper three quintiles were combined as upper wealth status (upper 60%) (Table 1).

Three outcome variables with binary categories, collectively called routine MNH visits included in this study, were i) EC of 4ANC visit; ii) EC of institutional delivery; iii) EC of PNC visit. For each MNH visit if score >0 and $\leq 0.8=0$ (poor coverage); and if score $>0.8=1$ (good coverage). The binary outcomes of each variable were coded as: 4ANC visits: 1= good coverage; 0=poor coverage; Institutional delivery: 1=good coverage; 0=poor coverage; PNC visit: 1= good coverage; 0=poor coverage.

Measurement of EC of routine MNH visits

Based on the information available in NDHS 2016, EC scores were calculated for those women who attended the health facilities for routine MNH visits. For EC of any MNH visit, women should receive sets of interventions by skilled providers, timely, adequate and appropriate content of care at the pregnancy [5], childbirth [44] and the postnatal period [45]. We identified selected MNH interventions (4ANC:16 items;

institutional delivery: 8 items; and PNC visits for mothers and newborns: 11 items) (Supplementary Table S2). Then we calculated the EC score of 4ANC visits, institutional delivery, and PNC visits. Scores (>0 to 1) were calculated for each MNH visit; if women received ten interventions in ANC visits, then the coverage score would be 0.625 (=10/16) [23]. For women who completed 4ANC visits, delivered at a health institution, or made a PNC visit, the coverage score would be >0 to 1 of each MNH visit [2]. Based on these woman-specific coverage scores of each MNH visit, population-level EC was calculated using formula $EC = Q \times U / N$ [46]. In this formula, EC refers to effective coverage of MNH visit at the national level, Q relates to the average quality score of all interventions of particular MNH visit (e.g. 4ANC visits), and U refers to the utilisation of MNH visit (the contact coverage of the MNH visit), and N is the number of population of need [2, 23].

For the regression analysis to identify determinants of EC of MNH visits, coverage scores were dichotomised, taking woman-specific score (of respective MNH visit). Although there are no gold standards of cut-off points for categorisation of poor or good effective coverage, this study took reference cut-off point of 0.80 to a previous study undertaken in Kenya [47] and Nepal [48]. Then scores were dichotomised into poor EC (if scores >0 and ≤ 0.8) and good EC (if scores >0.8) to identify the determinants of good EC of MNH visits. For each MNH visit, EC scores were dichotomised into poor EC (if score >0 and ≤ 0.8) and good EC (if score >0.8), that is i) EC of 4ANC visits, ii) EC of institutional delivery, and iii) EC of at least one PNC visit for mothers and newborns within 48 hours of childbirth.

Statistical analyses

All the analyses are adjusted for sampling weights available in the dataset to account for two-stage cluster sampling used in the NDHS 2016 survey (primary sampling unit=383; stratification (seven provinces with rural/urban dichotomy; strata=14); survey weights (probability weight =sample weight/1,000,000) [25]. Thus, results are representative at the national as well as strata levels. Statistical significance level was set $p < 0.05$ (two-tailed) to identify the determinants associated with the outcome variable. All reported estimates were weighted (unless otherwise indicated).

Binomial logistic regression analyses were conducted to identify determinants of EC

of MNH visits. Three independent multivariable logistic regression analyses were conducted for each outcome variable, for example, Model I for EC of 4ANC visits; Model II for EC of institutional delivery; Model III for EC of the first PNC visit for mothers and newborns within 48 hours of childbirth. The extent of inequities was reported in terms of odds ratios (OR) with 95% confidence intervals (CIs). Before running final regression model, multicollinearity was checked: excluded independent variables having variation inflation factors (VIF) ≥ 3 in the multivariable regression analyses [49]. Backward elimination multivariable logistic regression analyses were conducted [50]. For which, firstly, a full multivariable regression model was run, and then estimated p-values for each independent variable and the insignificant variable were identified. This procedure was repeated until no insignificant independent variable was left at $p < 0.2$ [51]. The adjusted odds ratios (aOR) with 95% CIs for all independent variables retaining $p < 0.05$ were reported. The goodness of fit tests was conducted using the Hosmer Lemeshow test (non-significant results ($p > 0.05$) indicated an adequate fit) [52]. All analyses were conducted using the survey command function and considering the clustering effect in Stata 14.0 (Stata Corp, 2015).

Results

Descriptive characteristics of women

Table 1 shows the background characteristics of the women included in the analysis. Among 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). 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 one in twenty 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 (or empowerment) in relation to access in health-seeking, buying something (financial empowerment) or meeting with relatives (movement authority). 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 perceived 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 delivered babies via C-section (Table 1).

Table 1: Characteristics of women who had a live birth in the two years preceding the survey in Nepal, NDHS 2016 (N=1978)

Determinants	Categories	Frequency, n (%)
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		
Language	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)
Provinces	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 (in years)	15-19	291 (14.7)
	20-34	1570 (79.7)
	35+	106 (5.3)
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)

Determinants	Categories	Frequency, n (%)
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 in the community	No	1340 (67.7)
	Yes	638 (32.3)
Mode of delivery	Normal (vaginal)	1780 (90.0)
	C-section	198 (10.0)
EC of 4ANC visits (n=1401)	Poor coverage	504(36.0)
	Good coverage	897(64.0)
EC of institutional delivery (n=1270)	Poor coverage	724 (57.0)
	Good coverage	546(43.0)
EC of first PNC visit (n=999)	Poor coverage	335 (33.5)
	Good coverage	664 (66.5)

Among 1,978 women, a total of 71% (n=1,401) women received four ANC visits; 64% (n=1,270) women delivered babies at health facilities assisted by skilled health personnel, and 51% (n=999) received at least one PNC visit for mothers and their newborns within 48 hours of childbirth. The average uptake of the interventions (quality score) of 4ANC visits, institutional delivery and first PNC visit was 0.73, 0.51, and 0.46, respectively. The population of need 100% of those who were gone through pregnancy, childbirth, and postnatal period. The EC of 4ANC visits, institutional delivery and PNC visit was 52%, 33% and 23%, respectively (Supplementary Table S2).

Table 2 shows the descriptive characteristics of the EC of routine MNH visits. Among 1,401 women who completed 4ANC visits, 64% received good EC of 4ANC visits. Women were more likely to receive good EC of 4ANC visits if they were a Nepali native speaker (76%), belonged to an advantaged ethnicity (80%), had a job (76%), lived in province seven (79%), had access to a bank account(77%), or perceived a problem of not having female provider present (80%), compared to their reference counterparts. Similarly, among women who delivered at health institutions (N=1270), 33% had good EC of institutional delivery. Women who were Nepali speakers (47%), belonged to an advantaged ethnicity (47%), lived in province four (51%) or a hill region (47%), or who had a history of uptake of 4ANC (51%) visits had good EC of institutional delivery compared to their reference counterparts. In addition, two-thirds

316 (66.5%, N=999) of women who accessed PNC services received good EC of PNC
317 visit. Women received good EC of their PNC visit if they had higher wealth status
318 (69%), higher (high school and above) maternal education (70%) or a job (77%), or
319 lived in province four (76%), had access to a bank account (72%), or delivered via
320 caesarean-section (87%) compared to their reference counterparts.

Table 2: Good EC of routine MNH visits in Nepal, NDHS 2016

Determinants	Categories	4ANC visits (N=1401)			Institutional delivery (N=1270)			PNC visit (N=999)		
		n	% of good EC	p	n	% of good EC	p	n	% of good EC	p
Structural										
Wealth status	Lower (40%)	539	61.5	0.242	405	42.1	0.692	329	60.8	0.035
	Upper (60%)	862	65.6		865	43.4		670	69.3	
Ethnicity	Disadvantaged	903	55.2	<0.001	819	41.0	0.078	615	64.0	0.110
	Advantaged	498	80.1		451	46.6		384	70.5	
Religion	Others	186	59.3	0.333	193	45.2	0.591	145	66.4	0.990
	Hindu	1,215	64.8		1,076	42.6		854	66.5	
Education	No	305	47.9	<0.001	270	38.5	0.278	207	60.9	0.060
	Primary	249	58.7		208	40.5		160	61.6	
	Secondary /higher	847	71.4		792	45.2		632	69.6	
Occupation	Not working	622	58.8	0.002	636	41.5	0.082	467	63.9	0.060
	Agriculture	596	65.7		460	41.6		387	65.6	
	Working paid	183	76.4		174	51.9		146	77.1	
Perceived violence	No	1,009	65.0	0.352	916	43.2	0.861	741	67.1	0.541
	Yes	393	61.6		354	42.6		258	64.7	
Decision-making authority	No	915	60.5	0.003	830	39.7	0.013	645	65.2	0.342
	Yes	486	70.7		439	49.3		354	68.9	
Household head	Male	1,002	62.6	0.168	908	42.1	0.375	700	65.8	0.565
	Female	400	67.5		361	45.3		299	68.2	
Intermediary										
Language	Nepali	673	76.2	<0.001	589	47.2	0.073	484	68.1	0.008
	Maithili	244	31.7		204	37.2		147	56.1	
	Bhojpuri	121	55.5		141	36.5		90	55.4	
	Others	363	65.9		336	41.9		278	72.7	
Residence	Urban	802	68.4	0.009	781	43.9	0.449	611	67.3	0.597
	Rural	599	58.1		489	41.6		388	65.3	
Provinces	One	266	59.7	<0.001	223	41.0	0.037	184	75.6	0.001
	Two	298	36.9		280	36.8		196	53.9	
	Three	236	76.4		226	50.6		196	70.4	
	Four	124	78.1		121	50.4		105	76.0	
	Five	272	71.9		239	46.0		187	67.4	
	Six	66	68.7		53	37.7		44	45.1	
	Seven	139	79.2		128	36.2		87	64.3	
Region	Mountain	94	62.4	<0.001	59	30.0	0.015	60	72.5	0.019

Determinants	Categories	4ANC visits (N=1401)			Institutional delivery (N=1270)			PNC visit (N=999)		
		n	% of good EC	p	n	% of good EC	p	n	% of good EC	p
	Hill	579	74.8		514	47.1		434	71.5	
	Terai	728	55.7		697	41.1		505	61.5	
Maternal age (in years)	15-19	216	54.5	0.003	206	41.2	0.322	145	65.8	0.838
	20-34	1,120	66.4		1,007	43.9		813	66.4	
	35+	66	54.9		57	32.3		41	71.0	
Birth order (index child)	<4	1,260	66.0	<0.001	1,153	44.0	0.081	903	68.4	0.001
	≥4	142	46.6		117	33.4		96	48.7	
Child sex (index child)	Male	756	65.3	0.337	698	44.3	0.330	563	67.3	0.631
	Female	645	62.5		572	41.3		436	65.5	
Access to bank account	No	904	57.1	<0.001	798	40.9	0.120	606	63.3	0.022
	Yes	498	76.6		472	46.5		393	71.5	
Media exposure	No	546	55.6	<0.001	463	40.6	0.184	332	58.6	0.002
	Yes	855	69.4		807	44.4		667	70.4	
Last birth (index child)	Unwanted	252	60.1	0.229	243	41.3	0.678	183	68.7	0.516
	Wanted	1,149	64.9		1,027	43.4		816	66.0	
Distance to health facilities	No problem	588	71.6	<0.001	581	45.3	0.174	468	70.6	0.037
	Big problem	814	58.6		689	41.0		531	62.9	
Health system										
Perceived problem if not having female providers	No Problem	438	79.6	<0.001	419	47.2	0.057	349	73.8	0.002
	Big problem	963	57.0		851	40.9		650	62.6	
Awareness on health mothers' group	No	904	59.9	<0.001	844	42.4	0.562	635	67.0	0.701
	Yes	497	71.6		426	44.2		364	65.6	
C-section delivery	No	1,235	62.8	0.023	1,072	44.7	0.016	834	62.4	<0.001
	Yes	166	73.2		198	34.0		165	86.9	
EC of 4ANC visits	Poor coverage				547	33.2	<0.00	383	56.9	<0.001
	Good				723	50.4		615	72.5	
EC of institutional delivery	Poor							541	64.0	0.111
	Good							457	69.4	

Note: p-values obtained by Fisher exact test, HMG: health mothers' group, EC: effective coverage, ANC: antenatal care, PNC: postnatal care.

Determinants of good EC of routine MNH visits

In the bivariable logistic analysis, 16 (of 19) variables were significantly associated with EC of 4ANC visits. Similarly, six (of 23) variables were significantly associated with good EC of institutional delivery. Total 12 (of 20) variables were significantly associated with good EC of PNC visit (Supplementary Table S3).

In the multivariate logistic regression analysis (Model I) for determinants of EC of 4ANC visits, six variables were significantly associated with good EC of 4ANC visits. Maithili speakers had lower odds (aOR=0.42; 95% CI: 0.20, 0.88) of good EC of 4ANC visits. There was good EC of 4ANC visits if women resided in province four (aOR=1.69; 95% CI: 1.02, 2.79) or seven (aOR=2.41; 95% CI: 1.46, 3.97), belonged to an advantaged ethnicity (aOR=1.68; 95% CI: 1.16, 2.43), and had a bank account (aOR=1.48; 95% CI: 1.08, 2.03) compared to their reference counterparts. Women with higher birth order (≥ 4) (aOR=0.54; 95% CI: 0.35, 0.85), and the perceived problem of not having female providers (aOR=0.47; 95% CI: 0.33, 0.67) were found to have a significant negative association with the uptake of good EC of 4ANC visits (Table 3).

In the multivariable analysis (Model II for determinants of EC of institutional delivery), two variables (mode of delivery and continuity of 4ANC visits) were significantly associated with EC of institutional delivery. Women who had delivery via caesarean-section had lower odds (aOR=0.54; 95% CI: 0.37, 0.80) of EC of institutional delivery services compared to women who had a normal delivery. Women with at least 4ANC visits during their pregnancy had higher odds (aOR=1.78; 95% CI: 1.33, 2.38) of good EC of institutional delivery compared to women who did not (Table 3).

In the multivariable analysis (Model III for determinants of EC of PNC visit), six variables were significantly associated with EC of PNC visit. Nepali speaker women (aOR=0.65; 95% CI: 0.43, 0.99), women from province six (aOR=0.34; 95% CI: 0.18, 0.64) and province seven (aOR=0.56; 95% CI: 0.31, 0.99), the perceived problem if not having female providers (aOR=0.67; 95% CI: 0.47, 0.96), or higher birth order (≥ 4) (aOR=0.52; 95% CI: 0.29, 0.93), had a significant negative association with EC of PNC visit. C-section (aOR=4.20; 95% CI: 2.29, 7.68), and EC of 4ANC visits (aOR=1.69; 95% CI: 1.18, 2.43) had a significant positive association with good EC of PNC visit (Table 3).

Table 3: Multivariable logistic regression for factors associated with good EC of routine MNH visits in Nepal, 2016 (N=1,978)

Determinants	Categories	Model I# aOR (95% CI)	Model II# aOR (95% CI)	Model III# aOR (95% CI)
Structural				
Ethnicity	Disadvantaged	1.00		
	Advantaged	1.68 (1.16, 2.43) **		
Intermediary				
Languages	Nepali	1.00		0.65*(0.43, 0.99)
	Maithili	0.42 (0.20, 0.88) *		0.48(0.22, 1.09)
	Bhojpuri	1.01(0.48, 2.14)		0.59(0.29,1.22)
	Others	0.82(0.53, 1.25)		1.00
Provinces	One	1.00		1.00
	Two	0.74(0.37,1.49)		0.73(0.37,1.46)
	Three	1.65(0.97, 2.80)		0.65(0.34,1.23)
	Four	1.69 (1.02, 2.79) *		0.92(0.47, 1.81)
	Five	1.47(0.88, 2.46)		0.72(0.44,1.18)
	Six	1.37(0.77, 2.43)		0.34 (0.18, 0.64) ***
	Seven	2.41 (1.46, 3.97) ***		0.56 (0.31,0.99) *
Birth order (index child)	<4	1.00		1.00
	≥4	0.54 (0.35, 0.85) **		0.52 (0.29, 0.93) *
Access to a bank account	No	1.00		
	Yes	1.48 (1.08, 2.03) *		
Health system				
Perceived problem not having female providers	No problem	1.00		1.00
	Big problem	0.47 (0.33,0.67) ***		0.67 (0.47, 0.96) *
Mode of delivery	C-section		0.54 (0.37, 0.80) **	4.20 (2.29, 7.68) ***
	Normal		1.00	1.00
EC of 4ANC visits	Poor		1.00	1.00
	Good		1.78 (1.33, 2.38) ***	1.69 (1.18, 2.43) **

Significance at *** p<0.001, ** p<0.01, * p<0.05. EC=effective coverage. Shaded cells: Variables not included in the analysis. Variables that had p<0.2 included in the final model.

#These are separate models adjusting for covariates listed in the respective column.

Model I: outcome variable: good EC of 4ANC visits. Independent variables: wealth status, language, ethnicity, religion, maternal education, maternal occupation, perceived violence, household head, residence, province, maternal age, child sex, access to a bank account, media exposure, index child, empowerment, distance to HFs, the perceived problem of not having female providers, awareness on health mothers' group, c-section delivery.

Model II: outcome variable: good EC of institutional delivery. Independent variables: all variables model I plus the EC of 4ANC visits.

Model III: outcome variable: Good EC of the first PNC visit. Independent variables: variables of model I plus the EC of 4ANC visit, and EC of institutional delivery.

Goodness of fit test (Hosmer Lemeshow test) for Model I (p= 0.575), Model 2 (p= 0.879), and Model III (p= 0.493). These figures show that our models are the best fit. P-values obtained by Fisher exact test. HMG: health mothers' group. EC= effective coverage, ANC: antenatal care, PNC: postnatal care.

Discussion

Summary of the findings

The effective coverage of 4ANC visits, institutional delivery, and PNC visit was 52%, 33% and 23%, respectively. These findings provide a baseline for the future estimation of the quality of MNH services in Nepal. Women with disadvantaged ethnicity or those from province six, speaking Maithili as the first language, and those who had high birth order (≥ 4) had lower odds of EC of MNH visits. Women who had access to a bank account, or women who had C-section delivery had higher odds of good EC of MNH visits. Women who perceived problem if not seen by female providers had poor EC of MNH visits compared to who did not care about the gender of health care providers.

EC of routine MNH visits and determinants

This study found low EC of all forms of MNH visits (4ANC visits, institutional delivery, and PNC visit) compared to contact coverage of respective coverage of MNH visit. For example, in Nepal, contact coverage of 4ANC visits, institutional delivery and first PNC visits was 71%, 64% and 51% respectively [53], but EC was lower than these figures. These suggest that women are reaching to HFs but not receiving all essential interventions. Yet, while contact coverage of routine MNH visits is essential on its own it is inadequate to avert MMR and NMR.

Poor EC of MNH visits identified in the current study are consistent with the studies conducted in Bangladesh [54], Cambodia [55], and other LMICs of South Asia and Sub Saharan Africa [18, 46]. Studies conducted in Nepal reported poor quality of ANC [48] and had low uptake of recommended antenatal interventions (e.g., ANC counselling or iron or tetanus toxoid injections) [56]. An analysis of multi-country data revealed low EC of facility delivery [57] and 4ANC visits and PNC visit [58] despite high contact coverage of respective MNH visits. Few studies also reported poor EC of other health services such as treatment of sick children (e.g., treatment of diarrhoea, pneumonia) [46] and family planning services [23, 46]. In addition to challenges in reaching to HFs, poor EC coverage may have contributed by the health system's weakness, such as poor readiness, including a lack of trained health workers, or shortages of medicine for MNH services.

The current study identified several determinants associated with EC of routine MNH services including ethnic and geographic disadvantage, Maithili speaking women, birth order, and gender of health care providers. First, in Nepal, ethnicity and socioeconomic status are associated with power and position in the society [59, 60]. Women with upper-caste groups usually have higher wealth status, usually are Nepali native speaker, they get a good opportunity for education and employment and are likely to have better awareness of health matters and the availability of health services. Disadvantaged ethnicities belong to the lower strata of the hierarchical caste system of Nepal [61]. Women with economic and ethnic disadvantages have poor access to health services in Nepal [62]. Health programs should focus on disadvantaged ethnicities and design context-specific strategies to provide effective health services to those groups.

Secondly, women of province six had poor EC that could be contributed by scattered settlements, poor transportation facilities with limited access to reach HFs [63]. Reaching HFs is problematic due to limited road networks and poor transportation facilities [64, 65]. Women's access to HFs can be improved via local development approaches such as constructing HFs in strategic locations and connecting community and health facilities by constructing bridges and road networks. However, these are non-health sector interventions that require multisectoral actions. Third, non-native Nepali speaker women, for instance, Maithili speaking women, usually have poor access to information. Poor access to health information might have contributed due to their low literacy rate [66]. Health education and information programs are not available in the local language, which affects health literacy among disadvantaged groups. In some cases, women cannot express their health care needs to health services providers if they could not understand Nepali or if health providers are unable to speak local languages. Recruitment of local health workforce and health education interventions conducted in local language can increase the uptake of MNH interventions.

Fourthly, women with high birth order (four or more) had poor EC of MNH visits in their recent pregnancy and childbirth. If women have more children, they may not prioritise the latest pregnancy and might not take the recommended MNH interventions in their pregnancy and childbirth [67]. Effective family planning services

could reduce the number of birth order [67, 68]. Women with wanted pregnancy visit health facility and take recommended MNH interventions for a healthy pregnancy and healthy childbirth. Fifth, some women prefer female providers for the uptake of MNH services in Nepal. Female health care providers can understand the need for health service users, and evidence indicates the provision of female providers can improve access to health services [69]. Similarly, if women receive good quality ANC, they are more likely to receive good quality institutional delivery services or PNC visit [37]. Improved quality of care is also likely to increase subsequent utilisation of MNH visits [56]. In nutshell, both access and health system response approaches care likely to improve EC of routine MNH visits. These approaches include equipping HFs with adequate supplies, trained health workers (e.g., local health workers who can understand local language and culture) and respectful maternity care and improved awareness on uptake of quality pregnancy, childbirth, and postnatal care from HFs.

This study demonstrated the measurement of the EC of routine MNH visits using NDHS data. The quality of care is emphasised in global health policies and universal access to quality MNH services SDG3 [9]; evaluating EC however, requires a population level measurement of quality of care. The EC of MNH visits can provide a proxy indicator of quality of care and go beyond simply contact coverage. This is important as evidence suggests access to health services alone cannot result in the intended MNH outcomes [13, 70]. Measurement of quality of care requires multiple sources of data, such as users, providers, facility inventory, and observation of interaction between providers and users [9, 71]. This study also demonstrates, however, a single source of data can be used to assess the health care quality. This study assessed the EC of routine MNH visits taking information on services users' engagement with the health system and using data of household survey and information on adequate care, timely care, and frequent and skilled care while women visit health facilities.

Policy and programmatic implications of the study

This study has implications for policies and programs. Firstly, the EC has been an important concept for its applicability in health system performance and could be instrumental in tracking the progress towards universal health coverage of MNH services [17]. Secondly, in Nepal, monitoring systems have given limited attention to

measuring the EC of health services including MNH services [72]. The methods used to estimate to assess the EC could provide ideas for the measurement of quality of health services. Thirdly, the universal coverage of quality MNH services are essential and need to focus on the quality of care for the reduction of NMR and MMR. To achieve SDG3 targets, the programmatic and policy focus should be beyond the contact coverage of MNH visits as only improving access to health services or contact coverage could not result in intended better MNH outcomes. Finally, this study identified disadvantaged women who were getting poor EC of MNH visits and identified the need for targeted approaches for effective uptake of MNH interventions among those groups. Programs and policies should focus on women with poor wealth status and ethnic disadvantages, and women speaking Maithili as the first language. Context-specific program approaches require to receive essential MNH interventions and ultimately improve the EC of MNH visits.

Limitations of the study

This study has some limitations. Firstly, data were self-reported, and thus, recall bias may occur. However, this study restricted to analysis among women who had a live birth in the two years prior to the survey (2014–2016), which is a relatively shorter recall period than other studies published using NDHS datasets in the past.

Secondly, outcome variables were self-reported by women during face-to-face interviews, which may lead to recall bias and social desirability bias. Thirdly, assessment of EC was limited by the information of MNH interventions available in the NDHS 2016. The NDHS did not collect information on all the WHO-recommended essential MNH interventions [4, 5, 45]. This study emphasises the importance of collecting information on MNH interventions in NDHS or routine HMIS system.

Conclusions

The uptake of recommended MNH interventions was low in all routine MNH visits (4 ANC visits, institutional delivery, and the first PNC visit) in Nepal. Poor EC of MNH visits was observed among women with social disadvantages, including those with ethnic disadvantage and living in remote areas. Both supply and demand-side multisectoral actions are needed to address several social determinants of health affecting poor EC of MNH visits in Nepal. Supply-side strategies such as recruiting female health providers and providing health commodities in HFs could improve the

health system responses for delivery of better quality MNH services. Improving the status of social determinant of health, community engagement, and health awareness through mass media on the antenatal, childbirth, and postnatal period could increase the demand of services for EC of routine MNH visits. Non- health sector interventions could improve the EC of routine MNH visits, including arranging transportation facilities or constructing local bridge and roads to reach HFs. Health policies and programs should focus on women with socioeconomic disadvantages and living in remote areas.

Supplementary file 1

Supplementary Table S1: Description of variables included in the analysis of effective coverage of routine MNH visits in Nepal, 2016

Supplementary Table S2: Uptake of interventions during MNH visits in Nepal, 2016

Supplementary Table S3: Bivariable binomial logistic regression analysis for good EC of MNH visits in Nepal

Abbreviations

ANC: Antenatal Care; CoC: Continuum of care; EC: Effective Coverage; 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 2016 NDHS. This survey 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) 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 the dataset for his doctoral thesis and this publication.

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

Design of the research, statistical analysis, interpretation: RBK. Writing first draft of manuscript: RBK and JD. Supervision of the study: RK, JD and YA. RBK, RK, JD and YA 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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