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## Difference in factors associated with Continuum of Care from pregnancy to post-partum period in rural Nepal: A community-based, cross-sectional study

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Raw data used in this study.sav	

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## **Title**

**Difference in factors associated with Continuum of Care from pregnancy to post-partum period in rural Nepal: A community-based, cross-sectional study**

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## **Keywords**

Pregnancy, Post-partum, Maternal health, Continuum of care, Decision-making, South Asia

## **Abstract**

### **Objectives**

Low-income countries, including Nepal, are hindered by multiple obstacles in the endeavor to increase coverage for the continuum of care (CoC). Hence, this study was conducted to investigate the CoC completion rate and its associated factors among mothers in two ecological regions in Nepal.

### **Design**

The team conducted a community-based, cross-sectional study, for which data were collected through face-to-face interviews using a structured questionnaire. From this information, multiple logistic regression analyses were conducted to determine the factors associated with CoC completion.

### **Setting**

This study was carried out in two rural districts of Nepal, in different regions: one in the hills (Dhading) and another in the flatlands (Nawalparasi). The interviews were taken in the time period between July and December 2016.

### **Participants**

Mothers who gave birth within a year before this study were included as participants. In total, there were 1,803 participants.

### **An outcome measure**

The outcome of this study was measured by the CoC completion rate among mothers.

### **Results**

The factors associated with the CoC completion rate varied by district. In Dhading, shorter travel time to a health facility and higher wealth quintiles were associated with a better CoC completion rate. Mothers who had a travel time of more than 15 minutes to a health facility were less likely to complete CoC compared to those living less than 15 minutes of travel time (aOR 0.24, 95% CI: 0.08-0.76). Meanwhile, in Nawalparasi, the CoC completion rate was affected by parity and decision-making for pregnancy care.

### **Conclusion**

The CoC completion rate was low in both districts, but the reasons varied for each region. In Dhading, the major constituents were traveling time to birthing centers and wealth quintiles, but it was parity and the person given decision-making authority for the location for ANC and delivery that had the largest effect in Nawalparasi.

### **Strengths and limitations of this study**

- This study found that the level of continuum of care (CoC) from pregnancy to post-partum was low in Nepal by comparing two ecological regions, which could not be done by typical secondary data analysis.
- This study considered women's knowledge, participation in health promotion, intrahousehold decision making, and birth preparedness as potential factors associated with CoC.
- The team was unable to validate participants' CoC measurements by using data from the health facility since mothers were found to use multiple locations for such care.

### **Funding Statement**

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### **Competing interests**

The authors have no competing interests.

## **Introduction**

Promoting Continuum of Care (CoC) from pregnancy to the post-partum period is one of the key approaches to improving maternal and newborn health (MNH). The World Health Organization (WHO) recommends CoC as a cost-effective intervention to improve MNH.<sup>1</sup> CoC usually refers to the continuity of individual care throughout the lifecycle (i.e., adolescence, pregnancy, childbirth, post-partum period, and childhood) and is explained by two dimensions: space and time.<sup>1,2</sup> In practice, the time dimension of CoC emphasize care for both mothers and newborns, from antenatal care (ANC) to post-natal care (PNC).<sup>3</sup> The space dimension, on the other hand, denotes optimal care-taking at households, communities, and health facilities.<sup>4-7</sup> The concept of CoC is crucial not only for planning and implementing interventions but also for policy and advocacy.<sup>7</sup>

ANC is the foundation for promoting CoC, as it signifies the pregnant women's first point of contact with health workers. If women receive ANC services continuously, they tend to follow the recommended actions and are more likely to give birth at health facilities, subsequently receiving proper care for their child.<sup>1</sup> Moreover, women are more likely to seek PNC if they underwent full ANC and delivery care at a health facility.<sup>1</sup> However, in the case of Nepal, many women fail to receive PNC even after completing ANC four times.<sup>8</sup>

Ensuring the provision of CoC to mothers and newborns is vital for improving MNH indicators in Nepal. Although Nepal has made significant progress in improving MNH indicators, maternal and neonatal mortality is still high. Thus, improving CoC can alleviate these problems. Notably, the maternal mortality ratio (MMR) decreased from 539 per 100,000 live births in 1996 to 239 deaths per 100,000 live births in 2016.<sup>8</sup> Nearly 69% of women received ANC for four times or more, 57% delivered in a health institution, and the same percentage of women received PNC within 48 hours of birth in 2016.<sup>8</sup>

Several mothers and newborns do not receive CoC owing to demand- and supply-side barriers. Previous studies in Nepal revealed that major demand-side barriers against access to MNH health services comprised the following factors: lack of awareness about pregnancy and post-partum care, long distance to health facilities, geographical difficulties, inadequate transport facilities, financial constraints, and lack of empowerment of women, particularly in decision-making regarding moving out from home.<sup>9-12</sup> Major supply-side barriers include

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3 inaccessibility and absenteeism of health workers and unavailability of services.<sup>13, 14</sup> These  
4 elements from both sides serve to prevent women from receiving essential services, as a  
5 result of which an overwhelming 41% of births took place at home and 43% of women did  
6 not receive any PNC in 2016.<sup>13</sup> However, the factors associated CoC completion is not well  
7 explored in Nepal.  
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13 Over the last two decades, inequality in MNH services across ecological regions has  
14 persistently been a major dilemma in Nepal.<sup>8, 15</sup> As for challenges related to CoC in  
15 particular, a huge difference exists between rural and urban populations.<sup>1, 16-19</sup> According to  
16 the Nepal Demographic and Health Survey (NDHS) 2016, 68% of the women from the hilly  
17 region received at least four ANC visits during their most recent pregnancy, whereas 52% of  
18 the women from Terai, flat land reported the same. Besides, 61% and 57% of women from  
19 the hills and the Terai region delivered in health facilities, respectively.<sup>8, 20, 21</sup> Moreover,  
20 about 62% of the women from the hills and 54% of the women from Terai received PNC  
21 within 48 hours of giving birth. Disparities in accessing proper MNH services based on  
22 socio-economic status and ethnicity have also been documented.<sup>8</sup> These data suggest that the  
23 women living in the hills perform better for each aspect of MNH care than the women in  
24 Terai.  
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36 The empowerment of women has important implications for their health outcomes, including  
37 the use of family planning and maternal health care services.<sup>8, 22</sup> The ability of women to  
38 make choices that affect their care-seeking practices in pregnancy is one of the indicators for  
39 women empowerment and autonomy in the decision-making process.<sup>23</sup> NDHS (i.e., 2016)  
40 depicted a variation in the level of empowerment between ecological regions. About 60% of  
41 the women from the hills and 56% of those from Terai usually make decisions independently  
42 or jointly with their husband regarding their health care.<sup>8</sup>  
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50 Since 1997, the Government of Nepal (GoN) has prioritized improving CoC in MNH,<sup>24</sup>  
51 making a policy to expand birthing centers down to the Village Development Committee  
52 (VDC) level, and also stressing on improving MNH services across the country.<sup>25</sup> To  
53 encourage institutional deliveries, the safe motherhood program was launched to provide  
54 cash incentives to mothers upon completion of ANC four times while ensuring delivery at the  
55 health institutions.<sup>16</sup> The previous studies focused on improving the coverage for each service  
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(ANC, institutional delivery, and PNC) separately; they did not consider CoC as an integrated concept. Additionally, not many studies focused on differences caused by variations in the ecological region within the same country. Hence, this study analyzed the CoC completion rate among mothers from two ecological regions in Nepal and examined the factors determining this rate in either region as well.

## **Methods**

### **Study design and setting**

This community-based, cross-sectional study took place in two ecological regions in Nepal.

Nepal has three ecological regions: mountains, hills, and Terai. The country is divided into 75 districts, among which 16 lie in the mountains, 39 in the hills, and 20 in the Terai.<sup>1, 6, 26, 27</sup> The hills form the largest part of Nepal (i.e., 68% of the total land). However, the largest share of the population lives in the Terai (i.e., 44%), despite it only covering 17% of the country's total landmass. Each ecological region has unique characteristics regarding climate, geography, infrastructure, culture, and access to health facilities. The districts segregate into smaller administrative units, municipalities, and VDCs, which further branch off into wards, representing the smallest administrative unit.

In this study, two districts were purposively selected: Dhading, a hill district, and Nawalparasi, a Terai district. The mountainous region was not targeted, as obtaining a sufficient sample was difficult. Dhading is the adjoining district of Kathmandu, the Capital of Nepal, which is also the only district where Comprehensive Obstetric Care (CEOC) is available. Nawalparasi, on the other hand, shares a border with India and lies in a plain region. The majority of the people belong to Terai-origin ethnic groups, such as the Madheshi. The study areas in both districts are different in terms of geography, ethnicity, access to health services, and socio-cultural behaviors. Furthermore, Hinduism is the dominant religion in both districts. Dhading district has a total population of 336,067 (178,233 women),<sup>8, 22</sup> while Nawalparasi has a total population of 643,508 (339,833 women).<sup>28</sup> This study was conducted in a western part of Nawalparasi with a total population of 343,886 (177,305 women). The chosen districts were comparable based on the availability of health facilities and the target population according to the Health Management Information

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3 System (HMIS). At least one health facility was available in each VDC. Both districts had a  
4 referral hospital for managing pregnancy-related complications. To balance population sizes  
5 while covering different geographical areas, 37 VDCs from the West part of Nawalparasi  
6 were included in this study. District headquarters and municipalities, however, were excluded  
7 from both districts.  
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13 The 2015 earthquakes heavily affected Dhading, thus the research team chose less-affected  
14 VDCs for this study. In the 49 VDCs and one municipality under Dhading, the earthquake  
15 caused 733 deaths; as such, the 12 selected VDCs were defined as less-affected areas.<sup>17, 28, 29</sup>  
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17 This study was conducted one and a half years after the disaster.  
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22 Nepal has diverse ethnic groups, which are delineated using language, ethnic identity or the  
23 caste system. Ethnicities are also categorized by common culture or the custom of marrying  
24 only within the limits of a local community, clan, or tribe. In this study, ethnic groups were  
25 classified into seven categories, as defined by the Central Bureau of Statistics (CBS),<sup>30</sup>  
26 namely: 1) Brahmin/Chhetri, 2) Terai/Madhesi castes, 3) Dalits, 4) Newar, 5) Janjati,  
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### 36 **Patient and public involvement**

37 We shared the details of the study plan with the district level health administrators. They  
38 provided the list of local level healthcare providers. We prepared the list of eligible mothers  
39 together with local level healthcare providers such as Auxiliary Nurse Midwives (ANMs) and  
40 Female Community Health Volunteers (FCHVs). Prior to study, seven potential participants  
41 reviewed the study instruments and provided their comments. We provided detail information  
42 of the study to household heads and obtained their permission before recruiting the study  
43 participants. After learning the details of the study, the mothers provided their consent to  
44 participate in the study voluntarily and provided information. We shared the main results of  
45 the study with in-charge of local health posts in both districts, who were willing to address  
46 some of the barriers identified in the study. We have a plan to share study findings with  
47 various stakeholders both in study districts and national level.  
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## Participants

The participants were mothers aged 16 to 49 years, who had given birth to a baby within the 12 months preceding this study. Additionally, only married mothers were included; childbearing in unmarried women is not accepted and a rare event in Nepal. The team also excluded mothers who were severely ill at the time of this study.

## Sample size

The sample size was calculated assuming coverage of key MNH services, from pregnancy to delivery and seven days' postpartum care of 5.8%, with reference to 8% in a previous study (significance level = 0.05; power = 0.8,  $df=2$ ).<sup>8,22</sup> The required sample size was 887 for each district; data from 1,803 mothers were collected: 903 from Dhading and 900 from Nawalparasi.

## Sampling procedure

Using a two-stage random sampling method, 1,803 mothers (i.e., 903 from Dhading and 900 from Nawalparasi districts) were selected for an interview. This study used the sampling frame according to the most recent population census of Nepal in 2011. VDC was considered the primary sampling unit and the population of each VDC ranged from 5,000 to 15,000 individuals. Out of 49 VDCs, data were collected from 12 VDCs in Dhading, and from the 37 VDCs in Nawalparasi, the team obtained data from 11 VDCs. Also, women were randomly selected from each VDC using probability proportional to size.

The household was the secondary sampling unit. To select it, the research team, consisting of the first author and data enumerators, went to the selected VDCs. Altogether, four data enumerators with experience in conducting interviews were recruited for each district. They were also trained in the process of obtaining informed consent and data collection. They were assigned to consult with local FCHVs and other local key informants to create the list of eligible mothers. FCHVs are the frontline healthcare volunteers in Nepal who update the list of pregnant and post-partum mothers. The list of eligible mothers in each selected household was prepared and confirmed with the FCHVs of the respective ward. The ANMs from the local health post were also consulted to confirm if any mothers were missing.

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3 After selecting the households, the team approached each household's primary decision-  
4 makers to seek permission for the mothers to be interviewed. This procedure was particularly  
5 important for Nepal as mothers-in-law, husbands, or father-in-law are generally the key  
6 decision-makers for the mother's health at the family level.<sup>31</sup> If more than one eligible mother  
7 lived in a household, the team only interviewed the mother of the youngest child. Formal  
8 informed consent was obtained from all mothers before the interview. All the mothers were  
9 interviewed separately, to safeguard their confidentiality and prevent the influence of any  
10 family members. The research team also confirmed the age, date of delivery, and the number  
11 of children with the mother for her eligibility to partake in this study. If a mother was not  
12 present during the first visit, the enumerators made a second visit on the next day, and if she  
13 was absent on the second visit as well, the next listed household was selected for an  
14 interview.  
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## 26 **Measurements**

### 27 **Dependent variable**

28 This study used the CoC completion rate as the dependent variable. The CoC completion rate  
29 was defined if a mother completes the following cares:

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34 i) At least four ANC check-ups (ANC4+) at four, six, eight, and nine months of pregnancy  
35 by the Auxiliary Nurse Midwives (ANM), and paramedics or doctors at a health facility, in  
36 community outreach clinics, or home,  
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38 ii) Delivery assisted by skilled birth attendants (e.g., doctor, nurse/midwife, auxiliary nurse  
39 midwife) at a health facility, and  
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41 iii) PNC for both mother and infant within 24 hours of delivery by health service providers at  
42 a health facility.  
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48 The Nepal Safe Motherhood Guidelines describe the CoC completion rate as a mother's  
49 completion of all of the above-mentioned care and two more PNC services on the third and  
50 seventh days after delivery.<sup>31</sup> This was collected in this study, too. Nonetheless, association  
51 with the modified definition of CoC was not measured in this study due to a smaller sample  
52 size of mothers, who completed three PNC visits. The above-mentioned indicators were used  
53 to construct a binary variable: 1 for mothers who completed CoC, and 2 for others.<sup>32</sup>  
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### Independent variables

This study required the measurement of several independent variables. First, as outlined in the NDHS, the team measured the socio-demographic characteristics: age, education, ethnicity, religion, occupation, travel time to the birthing center, and parity.<sup>33, 34</sup>

Thereafter, wealth quantiles were measured using a household assets index of 23 variables. The assets index was calculated according to the first component obtained in a principal component analysis, by accounting for house ownership, having a personal mobile phone, water source, availability of electricity at home, toilet type, household assets (including telephones, television set, video decks, refrigerators, cars, motorbikes, bicycles, tractors, cattle), cooking fuel, availability of toilets, and drinking water.<sup>22</sup> Data were recorded as “yes” if the mothers lived in their own home; if the floor of their house was made with parqueting, carpet, tile, or cement; if the house used zinc plate, tile, cement, or stone as roofing materials; and if the wall of the house consisted of brick, plywood, cement, or block. Additional variables included in the index were the following: having a radio, computer, wall clock, gas geyser, or solar panel. The response was also noted as “yes” if the family or mothers owned any of these items.

Third, the research team also measured other independent variables related to the mothers' most recent pregnancy, delivery, and post-natal periods. These were as follows:

- 1) Participation of mothers in the health mothers group meeting,
- 2) Knowledge and practice related to four ANC visits,
- 3) Decision-makers for ANC and delivery,
- 4) Spousal communication for choosing the place of delivery,
- 5) Experiencing any complications in pregnancy, delivery, and PNC, and
- 6) Planning with their husband to select the place of delivery.

The response was noted as “yes” if the mothers participated in the meeting; knew about the need of four ANC visitations; sought out four ANC services as prescribed; decided the place of delivery by themselves; shared with their husband; or faced any health problems in pregnancy, delivery, and PNC.

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3 In Nepal, many types of mothers' groups exist. Particularly, the health mothers' group is led  
4 by FCHVs. Such a group has to be formed in each ward and is supposed to behold meetings  
5 every month. During these meetings, women discuss their issues related to maternal,  
6 newborn, and child health (MNCH).  
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11 Planning with their husband to select the place of delivery was considered an independent  
12 variable because rural mothers need support from their family members to visit a health  
13 facility.  
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### 17 18 **Data collection**

19 A semi-structured questionnaire was used for interviewing the mothers while collecting the  
20 data. The questionnaire had been pre-tested in Nawalparasi.  
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25 Data were collected between July and December 2016 by eight experienced data enumerators  
26 who received a three-day training before being assigned to fieldwork. The training focused  
27 on sampling households, building rapport, explaining participants, obtaining informed  
28 consent, and administering the questionnaire. The data enumerators in Nawalparasi were  
29 familiar with the local language because many mothers in this district spoke a local language,  
30 Bhojpuri. After collection, all of the data were transported to the Kathmandu office of the  
31 local NGO Green Tara Nepal.  
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### 39 **Ethical consideration**

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41 Ethical approval for this study was obtained from the Research Ethics Committee of the  
42 Graduate School of Medicine, the University of Tokyo (Reference number 11204 dated 26<sup>th</sup>  
43 May 2016). It was also obtained from the Nepal Health Research Council (Reference number  
44 2125, dated 9<sup>th</sup> June 2016). All of the mothers were provided with an information sheet that  
45 contained explanations of the procedures, potential benefits and risks, and expected time for  
46 the interview. Furthermore, each mother gave her written informed consent before the  
47 interview proceeded; informed consent was read out for illiterate mothers and their  
48 thumbprint was taken on the sheet. Participation in this study was voluntary, and  
49 confidentiality was assured. Participants could choose to refuse to answer any question or  
50 discontinue the interview anytime without giving any reason.  
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## Statistical analysis

All data were entered into SPSS version 22.0, with missing values being crosschecked to maintain the completeness of the data. Descriptive and inferential statistics were computed. The team performed a descriptive analysis to explore the characteristics of the mothers by stratifying them into multiple categories. Descriptive statistics assisted in evaluating the socio-demographic characteristics of the mothers according to districts. Disaggregated results by districts have been presented in tables and figures.

Multiple logistic regression analyses were conducted to determine the factors associated with the level of CoC completion.<sup>22, 34</sup> The odds ratio (OR) denotes the odds of participants with completed CoC, compared with the odds of the participants who had not when adjusted for potential confounding variables - mainly age, ethnicity, religion, parity, wealth quintile, distance, knowledge on ANC, experiencing complications in ANC, delivery, and PNC. These variables were considered as major contributors to receiving care in MNCH.<sup>8, 22, 35</sup> The level of statistical significance was indicated by a p-value of less than 0.05.

## Results

### Socio-demographic characteristics of mothers by district

This study included 903 women in Dhading and 900 women in Nawalparasi. Table 1 shows the socio-demographic characteristics of mothers. More than 70% of the mothers in both Dhading and Nawalparasi districts were from the age group of 20–29 years. The mean age of the mothers was about 24 years in both districts. About 25% of the mothers in Dhading and 18% in Nawalparasi were illiterate. Hinduism was the dominant religion in both districts. Furthermore, 61% of the mothers were from Janjati in Dhading, whereas 59% of them belonged to Brahmin/Chhetri/Terai-origin ethnic groups in Nawalparasi West. In both districts, about 50% of the mothers had two to three children.

Moreover, 23% of the mothers from Dhading and 53% from Nawalparasi participated in the health mothers' group meeting. About 80% of the mothers from Dhading and 55% from Nawalparasi knew the need to have four ANC check-ups. The record of mothers receiving four ANC check-ups was about 50% in Dhading and around 35% in Nawalparasi. The odds of the mother deciding the place of ANC by herself were about 82% in Dhading and about

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3 53% in Nawalparasi. During the pregnancy period, more than 80% of the mothers from both  
4 districts discussed the place of delivery with their husbands. Additionally, in Dhading, 75%  
5 of the mothers decided the place of delivery independently, whereas only 27% in  
6 Nawalparasi reported the same. Further, 26% of the mothers from Dhading experienced  
7 complications in pregnancy, whereas 61% went through this ordeal in Nawalparasi.  
8 Likewise, 11% of the mothers from Dhading experienced problems at the time of delivery,  
9 whereas in Nawalparasi, such incidences were reported by 25% of the mothers. Nearly 15%  
10 and 46% of the mothers from Dhading and Nawalparasi, respectively, experienced problems  
11 in the post-partum period.  
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**Table 1. Socio-demographic characteristics of mothers by district**

Variables	<i>Frequency (%)</i>			
	<b>Dhading (n=903)</b>		<b>Nawalparasi (n=900)</b>	
	n	(%)	n	(%)
<b>Age group</b>				
Below 20 years	114	(12.6)	80	(9.0)
20-29 years	666	(73.8)	720	(80.0)
Above 30 years	123	(13.6)	100	(11.0)
Mean age (SD) years	24.2	(5.1)	24.2	(4.2)
<b>Education</b>				
None	221	(24.5)	162	(18.0)
Primary/Lower Secondary	452	(50.1)	437	(48.6)
Secondary and above	230	(25.5)	301	(33.4)
<b>Ethnicity</b>				
Bramhin/Chhetri/Terai other caste	236	(26.1)	528	(58.7)
Dalit	113	(12.5)	197	(21.9)
Janjati/other caste	554	(61.4)	73	(8.1)
Muslim	0	(0.0)	102	(11.3)
<b>Religion</b>				
Hindu	790	(87.5)	786	(87.3)
Other	113	(12.5)	114	(12.7)
<b>Travel time to birthing center</b>				
Less than 15 minute	98	(10.9)	148	(16.4)
15-60 minute	481	(53.3)	709	(78.8)
More than 60 minute	324	(35.9)	43	(4.8)
<b>Wealth quintiles</b>				
Lowest	90	(10.0)	272	(30.2)
Lower	97	(10.7)	262	(29.1)
Middle	152	(16.8)	209	(23.2)
Higher	228	(25.2)	134	(14.9)
Highest	336	(37.2)	23	(2.6)
<b>Parity</b>				
One	378	(41.9)	278	(30.9)
Two	300	(33.2)	312	(34.7)
Three or more	225	(24.9)	310	(34.4)
<b>Mothers participated in health mother's group meeting</b>				
Yes	208	(23.0)	498	(55.3)
No	695	(77.0)	402	(47.7)
<b>Knowledge on 4 ANC check-ups</b>				
Yes	747	(82.7)	501	(55.7)
No	156	(17.3)	399	(44.3)

**Table 2.** (Continued)

Variables	Frequency (%)			
	Dhading (n=903)		Nawalparasi (n=900)	
	n	(%)	n	(%)
<b>Completed 4 ANC check-ups</b>				
Yes	466	(51.6)	320	(35.6)
No	437	(48.4)	580	(64.4)
<b>Decision makers for ANC</b>				
Self	721	(81.8)	460	(53.4)
Mother-in-laws	129	(14.6)	116	(13.5)
Husband	8	(90.0)	131	(15.2)
Other family members	23	(2.6)	154	(17.9)
<b>Planning with husband for place of delivery</b>				
Yes	777	(86.0)	713	(82.6)
No	126	(14.0)	187	(14.7)
<b>Decision makers for delivery</b>				
Self	681	(75.4)	247	(27.4)
Others (MIL, Husband, FIL)	222	(24.6)	653	(72.6)
<b>Experienced any complications in pregnancy</b>				
Yes	235	(26.0)	552	(61.3)
No	668	(74.0)	348	(38.7)
<b>Experienced any complications during delivery</b>				
Yes	101	(11.2)	224	(24.9)
No	802	(88.8)	676	(75.1)
<b>Experienced any complications in PNC</b>				
Yes	136	(15.1)	417	(46.3)
No	767	(84.9)	483	(53.7)

ANC= Antenatal care, FIL= Father-in-law, MIL= Mother-in-law, PNC= Post-natal care

### Coverage of MNH services

Fig. 1 presents the CoC completion rate by the district. In sum, 52% of the mothers in Dhading completed four ANC check-ups, whereas 36% did so in Nawalparasi. About 70% of the mothers in both districts gave birth in a health institution. The first PNC showed records similar to the statistics for institutional delivery in both districts. The CoC completion rate was 41% in Dhading and 28% in Nawalparasi. This outcome validates a significant difference between the districts (adjusted OR [aOR]: 1.75, 95% CI: 1.44–2.13). Still, the reception of additional PNC on the third and the seventh day after birth was reported for only

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3 6% of women in Dhading and 3% in Nawalparasi and varied considerably by district (aOR:  
4 1.95, 95% CI: 1.23-3.09).  
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### 8 **Factors associated with CoC completion**

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10 The multi-variable analysis verified that the following factors were significantly different in  
11 at least one district: age, travel time to a health facility, wealth quintiles, parity, decision-  
12 makers for ANC, planning with husband to choose the place of delivery, and decision-makers  
13 concerning delivery. The associated factors for CoC varied by the district as shown in Table  
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20 In Dhading, travel time to a birthing center and wealth quintiles were associated with the  
21 CoC completion rate. The mothers who required traveling time of 15 minutes or more to  
22 reach the birthing centers had poorer CoC completion rate, as compared to the mothers who  
23 had to walk for less than 15 minutes (aOR: 0.24, 95% CI: 0.08-0.76). CoC completion rate  
24 also was poorer among the mothers who travelled for more than 60 minutes' walk to reach to  
25 the birthing centers than the mothers who walk for less than 15 minutes. For the mothers with  
26 more than 60 minutes' walk, it was (aOR: 0.51, 95% CI: 0.30-0.86). Mothers in Dhading  
27 from the lower, middle, higher, and highest wealth quintiles were found with a higher CoC  
28 completion rate, as compared to the lowest. It was significantly different in the mothers from  
29 the lower quintile (aOR: 8.68, 95% CI: 3.27-23.05). A similar trend was observed among the  
30 mothers with the middle, higher, and highest wealth quintiles, respectively (aOR: 3.50, 95%  
31 CI: 1.33-9.24; aOR: 4.49, 95% CI: 1.96-10.30 and aOR: 2.40, 95% CI: 1.15-5.02).  
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43 On the other hand, in Nawalparasi, parity and decision-making for ANC, planning with  
44 husband, and decision-making for delivery were associated with the CoC completion rate. In  
45 Dhading, however, such associations did not show a notable impact on the CoC completion  
46 rate. The mothers having only one child had a better CoC completion rate than those having  
47 two children (aOR: 0.33, 95% CI: 0.13-0.83). Mothers who independently opted for ANC  
48 were more likely to have a better CoC completion rate than those who relied on the decision  
49 of family members (aOR: 0.29, 95% CI: 0.15-0.58). Aside from that, the mothers who  
50 planned the place of delivery with their husband had a better CoC completion rate than the  
51 ones planning alone (aOR: 0.38, 95% CI: 0.15-0.96). In Nawalparasi, it was observed that if  
52 the decision-makers for delivery were other family members, particularly the mother-in-law,  
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father-in-law, or husbands, the mothers were more likely to have higher CoC completion rate (aOR: 3.03, 95% CI: 1.52-6.06).

**Table 2. Multiple variable analysis of CoC (4th ANC visit, institutional delivery and 1st PNC visit)**

Variables	Dhading (n=903) aOR (95% CI)	Nawalparasi (n=900) aOR (95% CI)
<b>Age group</b>		
Below 20 years	1.00	1.00
20-29 years	0.62 (0.20- 1.92)	4.38 (0.71-26.86)
Above 30 years	1.15 (0.50-2.64)	3.82 (0.97-15.05)
<b>Education</b>		
None	1.00	1.00
Primary/Lower Secondary	0.84 (0.33-2.11)	1.53 (0.51-4.57)
Secondary and above	1.19 (0.58-2.46)	1.54 (0.73-3.25)
<b>Ethnicity</b>		
Bramhin/Chhetri/Terai other caste	1.00	1.00
Dalit	0.67 (0.33-1.35)	2.29 (0.14-36.83)
Janjati/other caste	0.60 (0.28-1.32)	1.75 (0.13-24.66)
Muslim		1.75 (0.09-34.30)
<b>Religion</b>		
Hindu	1.00	1.00
Others	0.72 (0.39-1.34)	0.49 (0.04-5.81)
<b>Travel time to birthing center</b>		
Less than 15 minutes	1.00	1.00
15-60 minute	0.24 (0.08-0.76)*	0.62 (0.11-3.46)
More than 60 minutes	0.51 (0.30-0.86)*	1.53 (0.36-6.45)
<b>Wealth quintiles</b>		
Lowest	1.00	1.00
Lower	8.68 (3.27-23.05)***	1.21 (0.25-5.97)
Middle	3.50 (1.33-9.24)*	1.03 (0.22-4.87)
Higher	4.49 (1.96-10.30)***	0.82 (0.18-3.85)
Highest	2.40 (1.15-5.02)*	0.73 (0.15-3.60)
<b>Parity</b>		
One	1.00	1.00
Two	0.74 (0.37-1.49)	0.33 (0.13-0.83)*
Three or more	0.51 (0.25-1.02)	1.32 (0.60-2.89)
<b>Participated in health mothers' group meeting during pregnancy</b>		
Yes	1.00	1.00
No	0.80 (0.41-1.54)	1.29 (0.65-2.56)

**Table 2.** (Continued)

Variables	Dhading (n=903) aOR (95% CI)	Nawalparasi (n=900) aOR (95% CI)
<b>Knowledge on 4 ANC check-ups</b>		
Yes	1.00	1.00
No	0.97 (0.47-2.02)	0.96 (0.38-2.42)
<b>Decision makers for ANC</b>		
Self	1.00	1.00
Others (MIL, Husband, FIL)	1.00 (0.48-2.05)	0.29 (0.15-0.58)***
<b>Planning with husband for choosing the place of delivery</b>		
Yes	1.00	1.00
No	2.36 (0.95-5.81)	0.38 (0.15-0.96)*
<b>Decision makers for delivery</b>		
Self	1.00	1.00
Others (MIL, Husband, FIL)	0.71 (0.38-1.34)	3.03 (1.52-6.06)**
<b>Experienced any complications in pregnancy</b>		
Yes	1.00	1.00
No	1.10 (0.61-2.01)	0.58 (0.30-1.11)
<b>Experienced any complications during delivery</b>		
Yes	1.00	1.00
No	0.56 (0.21-1.50)	0.51 (0.21-1.21)
<b>Experienced any complications in PNC</b>		
Yes	1.00	1.00
No	1.18 (0.51-2.71)	0.90 (0.44-1.82)

ANC= Antenatal care, FIL= Father-in-law, MIL= Mother-in-law, PNC= Post-natal care

\*  $p < 0.05$

\*\*  $p < 0.01$

\*\*\*  $p < 0.001$

## **Discussion**

This study has two major findings. First, a huge gap existed in CoC completion rates between the two districts in different ecological regions. Second, associated factors for completing CoC differed by districts. They were travel time to the health facility, wealth quintiles, parity, decision-makers for choosing the place of ANC, planning with husband to choose the place

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3 of delivery, and decision-makers for delivery. Among these, traveling time to health facility  
4 and wealth quintile were associated in only Dhading and the other factors were associated  
5 only in Nawalparasi.  
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10 In this study, CoC completion rates in Dhading and Nawalparasi were 41% and 28%,  
11 respectively. Mothers receiving the four scheduled ANC check-ups that comply with the  
12 GoN recommendation in Dhading and Nawalparasi were recorded as 52% and 36%,  
13 respectively. This prevalence was lower than that of the NDHS in 2016; 68% in hills and  
14 52% in Terai regions of Nepal.<sup>8, 16</sup> In this study, mothers delivering at the health institutions  
15 made up 78% and 68% in Dhading and Nawalparasi, respectively. According to NDHS 2016,  
16 these were 61% and 57% in the hills and Terai regions, respectively.<sup>8</sup> Receiving the first PNC  
17 within the first 24 hours of birth was recorded to have occurred at an almost similar rate to  
18 the institutional delivery in both districts. The trend of institutional delivery and PNC visit  
19 within 24 hours of birth was similar to that observed in NDHS 2016.  
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29 The GoN recommends mothers and newborns to receive PNC three times, however, only 6%  
30 of mothers in Dhading and 3% in Nawalparasi were found completing CoC and receiving  
31 two additional instances of PNC on the third and seventh day of birth. It was quite low  
32 despite this intervention being a high priority program in Nepal.<sup>17</sup> It was much lower but  
33 similar to that reported in other studies.<sup>36, 37</sup> Interestingly, the prevalence reported in  
34 Cambodia was 5%, although the definition used there had been slightly different,<sup>36</sup> while in  
35 Ghana, it was only 8%.<sup>34, 38</sup> The results of this study were similar to a recent study in a  
36 district of Lao PDR, where the distance to the health facility and communication with family  
37 members were significantly associated with the completion of care in MNH.<sup>39</sup>  
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46 The context that promoted completing CoC, as seen in the study, varied by the district in the  
47 two ecological regions. The reasons for the variations were slightly different among the  
48 VDCs in both districts. In Dhading, the VDCs near the highway, in a clustered settlement,  
49 and with easy access to tertiary care hospitals in Kathmandu, recorded better CoC  
50 completions rates. Meanwhile, in Nawalparasi, the completion rate was higher in VDCs with  
51 birthing centers or with interventions for community health promotion.  
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3 Identifying the person within the household responsible for decision-making on maternal care  
4 is also a cardinal factor that shows an impact on the CoC completion rate. In addition to the  
5 women themselves, husbands, mothers-in-law (MIL), and fathers-in-law (FIL) were the key  
6 decision-makers at the family for maternity care in Nepal.<sup>8, 23, 40</sup> Also, the dynamics of  
7 decision-making within households were rather unique in Nawalparasi. The decision-making  
8 process for seeking health care regarding pregnancy and delivery was associated with CoC  
9 completion rate. Mothers in Nawalparasi were more dependent on their husbands, mother-in-  
10 law, and father-in-law in choosing the place of ANC or delivery than in Dhading. About 82%  
11 of the mothers in Dhading decided on ANC for themselves whereas only 53% did so in  
12 Nawalparasi. In total, 86% of the mothers in Dhading and 83% in Nawalparasi planned with  
13 their husband to select the place of delivery. About 75% of the mothers in Dhading and 27%  
14 of them in Nawalparasi decided the place of delivery independently. In Nawalparasi, mothers  
15 were more likely to complete CoC if they decided the place of ANC themselves or planned  
16 the selection of the place of delivery with their husband or mother-in-law. Such associations  
17 were not significant with the CoC completion rate in Dhading. Hence, this study affirmed  
18 that the family members' role (i.e., mainly mother-in-law) was prime in deciding the place of  
19 delivery in Nawalparasi. The mothers in Nawalparasi were less empowered, and therefore  
20 less involved in making decisions. Mostly the mother-in-law, husband, and father-in-law  
21 were the key decision-makers of the family. Other studies also explained that decision-  
22 making by the mother herself in choosing a place of delivery is generally uncommon in rural  
23 Nepal.<sup>23, 37, 40-42</sup>

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41 Several factors account for the low CoC in Nepal. Firstly, receiving care in a household or  
42 facility is not easy in Nepal. Visiting a health facility on the third and the seventh day after  
43 birth is also very difficult in Nepal. Geography, transport, culture, and lack of knowledge on  
44 perceived benefits of visiting health facilities hinder mothers from completing CoC.<sup>43-46</sup>  
45 Secondly, Nepal has no policy for home-based follow-ups for pregnant or post-partum  
46 mothers.<sup>47</sup> Thirdly, the household level decision-making process in maternity care is complex  
47 in Nepal. The mother herself cannot easily decide where to go for delivery. In addition to  
48 this, incentives may be a major contributing factor for higher ANC completion and  
49 institutional delivery rates. Besides, the mothers receive cash incentives for completing fourth  
50 ANC and institutional deliveries, however, such types of cash incentives are not available to  
51 mothers who complete three PNC visits. Lastly, the mothers in Nepal did not receive much  
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3 counseling for PNC by the health workers as opposed to ANC or institutional deliveries. The  
4 mothers also highlighted that health workers facilitated the completion of ANC visits and  
5 institutional deliveries but paid less attention to completing three PNC visits.  
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10 The suboptimal care-seeking practice is another significant impediment to CoC completion  
11 rates in both Dhading and Nawalparasi, as people tend to visit a health facility only when  
12 they are sick. The recommendations for increasing CoC should vary by district. In Dhading,  
13 increasing access should be a priority but the focus in Nawalparasi should be targeted  
14 towards empowering women to receive services.  
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20 This study has three limitations. First, it covers only the perspective of the mothers, and not  
21 that of the health facility staff. Also, the participants represent only mothers from the rural  
22 areas of Nepal. As such, the findings can only be generalized for rural women. Lastly,  
23 economic factors also influence the uptake of CoC even though this study was limited in this  
24 aspect.  
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### 30 **Conclusion**

31 The context for CoC completion rates was different in Dhading and Nawalparasi. The CoC  
32 completion rate in MNH was low in both districts compared to the national data of the same  
33 period, major factors for which were parity, travel time to a birthing center, wealth quintiles,  
34 spousal communication, decision-makers for ANC, and delivery. Travel time to a birthing  
35 center and wealth quintile were key factors for poor CoC in hilly districts of Nepal. However,  
36 family members' decision in seeking care for ANC and delivery was strongly associated with  
37 the CoC completion rate in the Terai. Increased access to health care is linked to a better CoC  
38 completion rate in Dhading. In the case of Nawalparasi, having a single child, the decision of  
39 mothers for pregnancy care, and the decision of mother-in-law for choosing the place of  
40 delivery were all related to the CoC completion rate.  
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51 This study presented an alarming situation as it is imperative to increase the number of  
52 people being able to avail second and third PNC visits in Nepal. Mothers and families face  
53 barriers in seeking PNC as defined by government policy. Therefore, government policies  
54 should be revised based on the realities identified in this study, in particular the timing of the  
55 second and third PNC check-ups. Home-based care by health workers is theoretically the way  
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3 to go, but the lack of resources remains a challenge hindering any substantial progress. More  
4 studies need to be undertaken to improve the situation of CoC completion rates in resource-  
5 limited settings.  
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13 their significant contribution. We are also grateful to all the mothers in the rural communities  
14 and the research assistants for their kind support in this study.  
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### 20 **Authors' Contributions**

21 RCS and MJ conceived and designed the experiments, while AKP, AS, and RCS collectively  
22 analyzed the data. MJ wrote the paper along with RCS and AS, and the finalization and  
23 review of the entire manuscript were done by all the authors: RCS, AS, AKP, SI, and MJ.  
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### 29 **Data sharing**

30 Data is shared as Supporting Information in this manuscript.  
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### 34 **Supplementary file**

35 Supplementary file: Raw data collected in this study  
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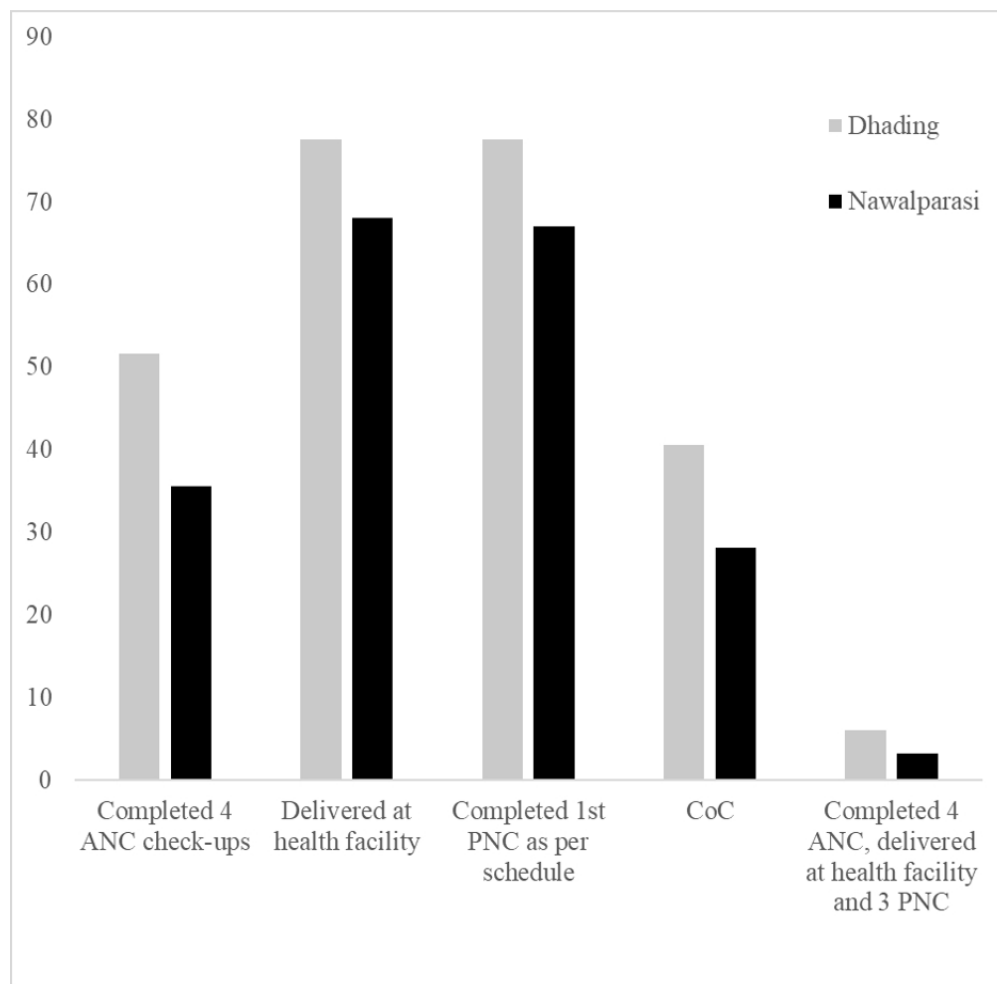


Fig 1. CoC completion rate by district (%) (n=1,803)

79x77mm (300 x 300 DPI)

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60STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	10-11
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11
		(b) Describe any methods used to examine subgroups and interactions	n/a
		(c) Explain how missing data were addressed	n/a
		(d) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(e) Describe any sensitivity analyses	n/a
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12
		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	Report numbers of outcome events or summary measures	14-15
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear	15-16

		which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	n/a
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	17-18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	20-21
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

\*Give information separately for exposed and unexposed groups.

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



# BMJ Open

## Difference in factors associated with continuum of care completion rate from pregnancy to post-partum period in rural Nepal: A community-based, cross-sectional study

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Keywords:	Maternal medicine < OBSTETRICS, EPIDEMIOLOGY, PUBLIC HEALTH, QUALITATIVE RESEARCH

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3 1 **Title**  
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5 2 **Difference in factors associated with continuum of care completion rate from pregnancy**  
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7 3 **to post-partum period in rural Nepal: A community-based, cross-sectional study**  
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9 4

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## 1 **Abstract**

### 2 **Objectives**

3 This study aimed to investigate the continuum of care completion rate in maternal, neonatal  
4 and child health and its associated factors among mothers in two ecological regions in Nepal.

### 5 **Design**

6 This was a community-based, cross-sectional study, for which data were collected through  
7 face-to-face interviews using a structured questionnaire. Multiple logistic regression analyses  
8 were conducted to determine the associated factors.

### 9 **Setting**

10 This was carried out in two rural districts of Nepal, in different regions: one in the hills  
11 (Dhading) and another in the flatlands called Terai (Nawalparasi). The data were collected  
12 between July and December 2016.

### 13 **Participants**

14 Mothers who gave birth within a year before this study were included as participants. In total,  
15 there were 1,803 participants.

### 16 **An outcome measure**

17 The outcome of this study was measured by the continuum of care completion rate when a  
18 mother completes four antenatal check-ups, deliver at a health facility, and receives post-  
19 natal care within 24 hours of delivery.

### 20 **Results**

21 The continuum of care completion rates were 41% in Dhading and 28% in Nawalparasi. In  
22 Dhading, shorter travel time to a health facility and higher wealth quintiles were associated  
23 with a better CoC completion rate. In Nawalparasi, the CoC completion rate was affected by  
24 parity and decision-making for pregnancy care.

### 25 **Conclusions**

26 The continuum of care completion rate was low in both districts. However, factors associated  
27 with the continuum of care completion rate varied by district. Differences in these factors  
28 might be reflected by geographic and socioeconomic conditions and the characteristics of  
29 household decision making in these districts.

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3 34 **Keywords**  
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5 35 Pregnancy, Post-partum, Maternal health, Continuum of care, Decision-making, South Asia  
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8 37 **Strengths and limitations of this study**  
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- 10 38 • In this study, the level of continuum of care were assessed from pregnancy to post-  
11 partum periods in two ecological regions of Nepal.  
12 39  
13 40 • Women's knowledge and behaviors were measured in these regions as potential  
14 factors associated with the continuum of care completion rate.  
15 41  
16 42 • Different associated factors were identified with the continuum of care completion  
17 rate in two ecological regions.  
18 43  
19 44 • Data were collected only from two ecological regions out of three as obtaining  
20 sufficient number of data was difficult in the mountain region.  
21 45  
22 46 • The mothers might have a chance of recall bias about the services they received since  
23 they were asked about them within a period of one year after delivery.  
24 47  
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26 49 **Funding Statement**  
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29 50 This research received no specific grant from any funding agency in the public, commercial,  
30 or not-for-profit sectors.  
31 51  
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33 53 **Competing interests**  
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36 54 The authors have no competing interests.  
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## 57 **Background**

58 Promoting Continuum of Care (CoC) from pregnancy to the post-partum period is one of the  
59 key approaches to improving maternal and newborn health (MNH). The World Health  
60 Organization (WHO) recommends CoC as a cost-effective intervention to improve MNH.<sup>1</sup>  
61 CoC usually refers to the continuity of individual care throughout the lifecycle (i.e.,  
62 adolescence, pregnancy, childbirth, post-partum period, and childhood) and is explained by  
63 two dimensions: space and time.<sup>1,2</sup> In practice, the time dimension of CoC emphasize care  
64 for both mothers and newborns, from antenatal care (ANC) to post-natal care (PNC).<sup>3</sup> The  
65 space dimension, on the other hand, denotes optimal care-taking at households, communities,  
66 and health facilities.<sup>4-7</sup>

67  
68 Several mothers and newborns do not receive CoC owing to demand- and supply-side  
69 barriers. Major demand-side barriers against access to MNH health services comprised the  
70 following factors: lack of awareness about pregnancy and post-partum care, long distance to  
71 health facilities, geographical difficulties, inadequate transport facilities, financial constraints,  
72 and lack of empowerment of women, particularly in decision-making regarding moving out  
73 from home.<sup>8-11</sup> Major supply-side barriers include inaccessibility and absenteeism of health  
74 workers and unavailability of services.<sup>12,13</sup> These elements from both sides serve to prevent  
75 women from receiving essential services. Nepal Demographic Health Survey (2016) showed  
76 that 69% of the women received four ANC, 58% of them delivered at the health facility and  
77 57% received PNC within 2 days of delivery.<sup>14</sup>

78  
79 Ensuring the provision of CoC to mothers and newborns is vital for improving MNH  
80 indicators in Nepal. Therefore, since 1997, the Government of Nepal (GoN) has prioritized  
81 improving CoC in MNH, making a policy to expand birthing centers down to the Village  
82 Development Committee (VDC) level, and also stressing on improving MNH services across  
83 the country.<sup>15</sup> If women receive ANC services continuously, they tend to follow the  
84 recommended actions and are more likely to give birth at health facilities, subsequently  
85 receiving proper care for their child. Moreover, women are more likely to seek PNC if they  
86 underwent full ANC and delivery care at a health facility.<sup>1</sup> However, in Nepal, many women  
87 fail to receive PNC even after completing four ANC.<sup>14</sup>

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3 89 Multiple factors are known to be associated with CoC completion rate in Nepal. These factors  
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5 90 include distance to health facilities, ethnicity, access to radio and television, spousal  
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7 91 communication, frequency of ANC, knowledge on ANC and PNC, wealth quintile,  
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9 92 education, parity and decision-makers for ANC and delivery.<sup>16-18</sup> These factors, however,  
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11 93 have not been identified considering regional differences. Nepal consists of nearly 60 ethnic  
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13 94 groups, and people live in three ecological regions; mountain (4,877 to 8,848 m), hill (610  
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15 95 meters to 4,876 m), and flatland called Terai (< 610 m).<sup>19, 20</sup> The type of the factors for CoC  
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17 96 completion rate may vary among these ecological regions.

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19 98 For taking a tailor-made public health approach to improve CoC completion rate,  
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21 99 investigating the region-specific factors are crucial. In this study, the CoC completion rate  
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23 100 was first analyzed among mothers from two ecological regions in Nepal. Then, associated  
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25 101 factors with the CoC completion rate were investigated in each region.

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## 27 103 **Methods**

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### 30 105 **Study design and setting**

31 106 This community-based, cross-sectional study took place in two ecological regions in Nepal.

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34 108 Nepal is divided into 75 districts, among which 16 lie in the mountains, 39 in the hills, and 20  
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36 109 in the Terai. The hills form the largest part of Nepal (i.e., 68% of the total land). However,  
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38 110 the largest share of the population lives in the Terai (i.e., 44%), despite it only covering 17%  
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40 111 of the country's total landmass. Each ecological region has unique characteristics regarding  
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42 112 climate, geography, infrastructure, culture, and access to health facilities. The districts  
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44 113 segregate into smaller administrative units, municipalities, and VDCs, which further branch  
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46 114 off into wards, representing the smallest administrative unit.

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49 116 In this study, two districts were purposively selected: Dhading, a hill district, and  
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51 117 Nawalparasi, a Terai district. The mountainous region was not targeted, as obtaining a  
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53 118 sufficient number of mothers was difficult. Dhading is the adjoining district of Kathmandu,  
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55 119 the Capital of Nepal, which is also the only district where Comprehensive Obstetric Care  
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57 120 (CEOC) is available. Nawalparasi, on the other hand, shares a border with India and lies in a  
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59 121 Terai region. The majority of the people belong to Terai-origin ethnic groups, such as the

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3 122 Madheshi. Dhading district has a total population of 336,067 (178,233 women), while  
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5 123 Nawalparasi has a total population of 643,508 (339,833 women).<sup>21, 22</sup> This study was  
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7 124 conducted in a western part of Nawalparasi with a total population of 343,886 (177,305  
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9 125 women). The chosen districts were comparable based on the availability of health facilities  
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11 126 and the target population according to the Health Management Information System (HMIS).  
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13 127 At least one health facility was available in each VDC. Both districts had a referral hospital  
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15 128 for managing pregnancy-related complications. To balance population sizes while covering  
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17 129 different geographical areas, 37 VDCs from the West part of Nawalparasi were included in  
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19 130 this study. District headquarters and municipalities, however, were excluded from both  
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21 131 districts.

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23 133 The 2015 earthquakes heavily affected Dhading, thus the research team chose less-affected  
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25 134 VDCs for this study. In the 49 VDCs and one municipality under Dhading, the earthquake  
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27 135 caused 733 deaths; as such, the 12 selected VDCs were defined as less-affected areas.<sup>22</sup> This  
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29 136 study was conducted one and a half years after the disaster.

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31 138 About 60 diverse ethnic groups in Nepal are delineated using language, ethnic identity or the  
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33 139 delineated using language, ethnic identity or the caste system.<sup>23</sup> Ethnicities are also  
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35 140 categorized by common culture or the custom of marrying only within the limits of a local  
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37 141 community, clan, or tribe. In this study, ethnic groups were classified into seven categories,  
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39 142 as defined by the Central Bureau of Statistics (CBS),<sup>24, 25</sup> namely: 1) Brahmin/Chhetri, 2)  
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41 143 Terai/Madheshi castes, 3) Dalits, 4) Newar, 5) Janjati, 6) Muslims, and 7) Others.

#### 42 43 145 **Patient and public involvement**

44  
45 146 The details of the study plan were shared with the district level health administrators. They  
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47 147 provided the list of local level healthcare providers.-The list of eligible mothers was then  
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49 148 prepared together with local level healthcare providers such as Auxiliary Nurse Midwives  
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51 149 (ANMs) and Female Community Health Volunteers (FCHVs). Prior to study, seven potential  
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53 150 participants reviewed the study instruments and provided their comments.-Detailed  
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55 151 information of the study was provided to household heads and obtained their permission  
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57 152 before recruiting the study participants. After learning the details of the study, the mothers  
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59 153 provided their consent to participate in the study voluntarily and provided information. The  
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154 main results of the study were shared with in-charge of local health posts in both districts,



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3 155 who were willing to address some of the barriers identified in the study. Study findings will  
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5 156 be shared with various stakeholders both in study districts and national level.  
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### 8 158 **Participants**

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10 159 The participants were mothers aged 16 to 49 years, who had given birth to a baby within the  
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12 160 12 months preceding this study. Additionally, only married mothers were included;  
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14 161 childbearing in unmarried women is not accepted and a rare event in Nepal. The team also  
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16 162 excluded mothers who were severely ill at the time of this study.  
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### 19 164 **Sample size**

20 165 The sample size was calculated assuming coverage of key MNH services, from pregnancy to  
21  
22 166 delivery and seven days' postpartum care of 5.8%, with reference to 8% in a previous study  
23  
24 167 (significance level = 0.05; power = 0.8, df=2).<sup>14, 26-28</sup> The required sample size was 887 for  
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26 168 each district; data from 1,803 mothers were collected: 903 from Dhading and 900 from  
27  
28 169 Nawalparasi.  
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### 31 171 **Sampling procedure**

32 172 Using a two-stage random sampling method, 1,803 mothers (i.e., 903 from Dhading and 900  
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34 173 from Nawalparasi districts) were selected for an interview. This study used the sampling  
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36 174 frame according to the most recent population census of Nepal in 2011. VDC was considered  
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38 175 the primary sampling unit and the population of each VDC ranged from 5,000 to 15,000  
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40 176 individuals. Out of 49 VDCs, data were collected from 12 VDCs in Dhading, and from the 37  
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42 177 VDCs in Nawalparasi, the team obtained data from 11 VDCs. Also, women were randomly  
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44 178 selected from each VDC using probability proportional to size.  
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47 180 The household was the secondary sampling unit. To select it, the research team, consisting of  
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49 181 the first author and data enumerators, went to the selected VDCs. Altogether, four data  
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51 182 enumerators with experience in conducting interviews were recruited for each district. They  
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53 183 were also trained in the process of obtaining informed consent and data collection. They were  
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55 184 assigned to consult with local FCHVs and other local key informants to create the list of  
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57 185 eligible mothers. FCHVs are the frontline healthcare volunteers in Nepal who update the list  
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59 186 of pregnant and post-partum mothers. The list of eligible mothers in each selected household  
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3 187 was prepared and confirmed with the FCHVs of the respective ward. The ANMs from the  
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5 188 local health post were also consulted to confirm if any mothers were missing.

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8 190 The data were directly collected from the post-partum mothers. Informed consent was  
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10 191 obtained from them before collecting the data. However, mothers-in-law or fathers-in-law  
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12 192 were met during interview as a courtesy. When the data collection team reached the targeted  
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14 193 household, the head of family was explained the objectives of visit, who were mostly  
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16 194 mothers-in-law or fathers-in-law. This was important to build a rapport with them so that they  
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18 195 will not be surprised at their daughter-in-law was being interviewed. This is a common  
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20 196 practice for fieldwork in Nepal. If more than one eligible mother lived in a household, the  
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22 197 team only interviewed the mother of the youngest child. All the mothers were interviewed  
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24 198 separately, to safeguard their confidentiality and prevent the influence of any family  
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26 199 members. The research team also confirmed the age, date of delivery, and the number of  
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28 200 children with the mother for her eligibility to partake in this study. If a mother was not  
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30 201 present during the first visit, the enumerators made a second visit on the next day, and if she  
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32 202 was absent on the second visit as well, the next listed household was selected for an  
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34 203 interview.

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## 37 205 **Measurements**

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### 40 207 **Dependent variable**

41 208 This study used the CoC completion rate as the dependent variable. The CoC completion rate  
42  
43 209 was defined if a mother completes the following cares:

44 210 i) At least four ANC check-ups (ANC4+) at four, six, eight, and nine months of pregnancy  
45  
46 211 by the Auxiliary Nurse Midwives (ANM), and paramedics or doctors at a health facility, in  
47  
48 212 community outreach clinics, or home,

49 213 ii) Delivery assisted by skilled birth attendants (e.g., doctor, nurse/midwife, auxiliary nurse  
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51 214 midwife) at a health facility, and

52 215 iii) PNC for both mother and infant within 24 hours of delivery by health service providers at  
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54 216 a health facility.

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57 218 Different from the standardized WHO guidelines, Nepal changed government the policy in  
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59 219 2007 to change the timing of PNC visits; first in 24 hours of birth (PNC 1), second on the

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3 220 third day (PNC 2) and third on seventh day (PNC 3).<sup>29, 30</sup> The first week of births was crucial  
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5 221 both to the mothers and newborns in Nepal, which was the reason behind changing the  
6  
7 222 policy. The Nepal Safe Motherhood and Newborn Health Road Map describes the CoC  
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9 223 completion rate if a mother completes all of the above-mentioned visits.<sup>30</sup> So, only PNC 1  
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11 224 is not the standard definition in Nepal. However, as the rate of PNC 2 and PNC 3 was very  
12  
13 225 low in this study, only PNC 1 was included for analyzing the association with CoC  
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15 226 completion rate. The above-mentioned indicators were used to construct a binary variable: 1  
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17 227 for mothers who completed CoC, and 2 for mothers who did not complete it.  
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### 229 **Independent variables**

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21 230 This study required the measurement of several independent variables. First, as outlined in  
22  
23 231 the NDHS, the team measured the socio-demographic characteristics: age, education,  
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25 232 ethnicity, religion, occupation, travel time to the birthing center, and parity.<sup>26, 31</sup>  
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29 234 Thereafter, wealth quantiles were measured using a household assets index of 23 variables.  
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31 235 The assets index was calculated according to the first component obtained in a principal  
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33 236 component analysis, by accounting for house ownership, having a personal mobile phone,  
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35 237 water source, availability of electricity at home, toilet type, household assets (including  
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37 238 telephones, television set, video decks, refrigerators, cars, motorbikes, bicycles, tractors,  
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39 239 cattle), cooking fuel, availability of toilets, and drinking water.<sup>32</sup> Data were recorded as  
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41 240 “yes” if the mothers lived in their own home; if the floor of their house was made with  
42  
43 241 parqueting, carpet, tile, or cement; if the house used zinc plate, tile, cement, or stone as  
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45 242 roofing materials; and if the wall of the house consisted of brick, plywood, cement, or block.  
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47 243 Additional variables included in the index were the following: having a radio, computer, wall  
48  
49 244 clock, gas geyser, or solar panel. The response was also noted as “yes” if the family or  
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51 245 mothers owned any of these items.  
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55 247 Third, the research team also measured other independent variables related to the mothers’  
56  
57 248 most recent pregnancy, delivery, and post-natal periods. These were as follows:

- 58 249 1) Participation of mothers in the health mothers group meeting,
- 59 250 2) Knowledge and practice related to four ANC visits,
- 60 251 3) Decision-makers for ANC and delivery,
- 252 250 4) Spousal communication for choosing the place of delivery,

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3 253 5) Experiencing any complications in pregnancy, delivery, and PNC, and

4 254 6) Planning with their husband to select the place of delivery.

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8 256 The response was noted as “yes” if the mothers participated in the meeting; knew about the  
9 257 need of four ANC visitations; sought out four ANC services as prescribed; decided the place  
10 258 of delivery by themselves; shared with their husband; or faced any health problems in  
11 259 pregnancy, delivery, and PNC.

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14  
15 261 In Nepal, many types of mothers’ groups exist. Particularly, the health mothers’ group is led  
16 262 by FCHVs. Such a group has to be formed in each ward and is supposed to hold meetings  
17 263 every month. During these meetings, women discuss their issues related to maternal,  
18 264 newborn, and child health (MNCH).

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21 266 Planning with their husband to select the place of delivery was considered an independent  
22 267 variable because rural mothers need support from their family members to visit a health  
23 268 facility.

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### 26 270 **Data collection**

27 271 A semi-structured questionnaire was used for interviewing the mothers while collecting the  
28 272 data. The questionnaire had been pre-tested in Nawalparasi.

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31 274 Data were collected between July and December 2016 by eight experienced data enumerators  
32 275 who received a three-day training before being assigned to fieldwork. The training focused  
33 276 on sampling households, building rapport, explaining participants, obtaining informed  
34 277 consent, and administering the questionnaire. The data enumerators in Nawalparasi were  
35 278 familiar with the local language because many mothers in this district spoke a local language,  
36 279 Bhojpuri. After collection, all of the data were transported to the Kathmandu office of the  
37 280 local NGO Green Tara Nepal.

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### 40 282 **Ethical consideration**

41 283 Ethical approval for this study was obtained from the Research Ethics Committee of  
42 284 the Graduate School of Medicine, the University of Tokyo (Reference number 11204  
43 285 dated 26<sup>th</sup> May, 2016). It was also obtained from the Nepal Health Research Council

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3 286 (Reference number 2125, dated 9<sup>th</sup> June, 2016). All of the mothers were provided  
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5 287 with an information sheet that contained explanations of the procedures, potential  
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7 288 benefits and risks, and expected time for the interview. Furthermore, each mother  
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9 289 gave her written informed consent before the interview proceeded; informed consent  
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11 290 was read out for illiterate mothers and their thumbprint was taken on the sheet.  
12  
13 291 Participation in this study was voluntary, and confidentiality was assured. Participants  
14  
15 292 could choose to refuse to answer any question or discontinue the interview anytime  
16  
17 293 without giving any reason.

### 294 295 **Statistical analysis**

296 All data were entered into SPSS version 22.0, with missing values being crosschecked to  
297  
298 maintain the completeness of the data. Descriptive and inferential statistics were computed.  
299  
300 The team performed a descriptive analysis to explore the characteristics of the mothers by  
301  
302 stratifying them into multiple categories. Descriptive statistics assisted in evaluating the  
303  
304 socio-demographic characteristics of the mothers according to districts. Disaggregated results  
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306 by districts have been presented in tables and figures.  
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308 Multiple logistic regression analyses were conducted to determine the factors associated with  
309  
310 the level of CoC completion.<sup>26, 32</sup> The odds ratio (OR) denotes the odds of mothers with  
311  
312 completed CoC, compared with those of the mothers who had not when adjusted for potential  
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314 confounding variables - mainly age, ethnicity, religion, parity, wealth quintile, distance,  
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316 knowledge on ANC, experiencing complications in ANC, delivery, and PNC. These variables  
317  
318 were considered as major contributors to receiving care in MNCH.<sup>14, 20, 32, 33</sup> The level of  
319  
320 statistical significance was indicated by a p-value of less than 0.05.

## 321 **Results**

### 322 323 324 **Socio-demographic characteristics of mothers by district**

325 This study included 903 women in Dhading and 900 women in Nawalparasi. Table 1 shows  
326  
327 the socio-demographic characteristics of mothers. More than 70% of the mothers in both  
328  
329 Dhading and Nawalparasi districts were from the age group of 20–29 years. The mean age of  
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331 the mothers was about 24 years in both districts. About 25% of the mothers in Dhading and  
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333 18% in Nawalparasi were illiterate. Hinduism was the dominant religion in both districts.

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3 319 Furthermore, 61% of the mothers were from Janjati in Dhading, whereas 59% of them  
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5 320 belonged to Brahmin/Chhetri/Terai-origin ethnic groups in Nawalparasi West. In both  
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7 321 districts, about 50% of the mothers had two to three children.

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10 323 Moreover, 23% of the mothers from Dhading and 53% from Nawalparasi participated in the  
11  
12 324 health mothers' group meeting. About 80% of the mothers from Dhading and 55% from  
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14 325 Nawalparasi knew the need to have four ANC check-ups. The record of mothers receiving  
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16 326 four ANC check-ups was about 50% in Dhading and around 35% in Nawalparasi. The odds  
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18 327 of the mother deciding the place of ANC by herself were about 82% in Dhading and about  
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20 328 53% in Nawalparasi.

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23 330 During the pregnancy period, more than 80% of the mothers from both districts discussed the  
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25 331 place of delivery with their husbands. In Dhading, 75% of the mothers decided the place of  
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27 332 delivery independently, whereas only 27% in Nawalparasi reported the same. Further, 26% of  
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29 333 the mothers from Dhading experienced complications in pregnancy, whereas 61% went  
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31 334 through this ordeal in Nawalparasi. Likewise, 11% of the mothers from Dhading experienced  
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33 335 problems at the time of delivery, whereas in Nawalparasi, such incidences were reported by  
34  
35 336 25% of the mothers. Nearly 15% and 46% of the mothers from Dhading and Nawalparasi,  
36  
37 337 respectively, experienced problems in the post-partum period.

338 **Table 1.** Socio-demographic characteristics of mothers by district

Variables	<i>Frequency (%)</i>			
	<b>Dhading (n=903)</b>		<b>Nawalparasi (n=900)</b>	
	n	(%)	n	(%)
<b>Age group</b>				
Below 20 years	114	(12.6)	80	(9.0)
20-29 years	666	(73.8)	720	(80.0)
Above 30 years	123	(13.6)	100	(11.0)
Mean age (SD) years	24.2	(5.1)	24.2	(4.2)
<b>Education</b>				
None	221	(24.5)	162	(18.0)
Primary/Lower Secondary	452	(50.1)	437	(48.6)
Secondary and above	230	(25.5)	301	(33.4)
<b>Ethnicity</b>				
Bramhin/Chhetri/Terai other caste	236	(26.1)	528	(58.7)
Dalit	113	(12.5)	197	(21.9)
Janjati/other caste	554	(61.4)	73	(8.1)
Muslim	0	(0.0)	102	(11.3)
<b>Religion</b>				
Hindu	790	(87.5)	786	(87.3)
Other	113	(12.5)	114	(12.7)
<b>Travel time to birthing center</b>				
Less than 15 minute	98	(10.9)	148	(16.4)
15-60 minute	481	(53.3)	709	(78.8)
More than 60 minute	324	(35.9)	43	(4.8)
<b>Wealth quintiles</b>				
Lowest	90	(10.0)	272	(30.2)
Lower	97	(10.7)	262	(29.1)
Middle	152	(16.8)	209	(23.2)
Higher	228	(25.2)	134	(14.9)
Highest	336	(37.2)	23	(2.6)
<b>Parity</b>				
One	378	(41.9)	278	(30.9)
Two	300	(33.2)	312	(34.7)
Three or more	225	(24.9)	310	(34.4)
<b>Mothers participated in health mother's group meeting</b>				
Yes	208	(23.0)	498	(55.3)
No	695	(77.0)	402	(47.7)
<b>Knowledge on 4 ANC check-ups</b>				
Yes	747	(82.7)	501	(55.7)
No	156	(17.3)	399	(44.3)

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340 **Table 1.** (Continued)

Variables	Frequency (%)			
	Dhading (n=903)		Nawalparasi (n=900)	
	n	(%)	n	(%)
<b>Completed 4 ANC check-ups</b>				
Yes	466	(51.6)	320	(35.6)
No	437	(48.4)	580	(64.4)
<b>Decision makers for ANC</b>				
Self	721	(81.8)	460	(53.4)
Mother-in-laws	129	(14.6)	116	(13.5)
Husband	8	(90.0)	131	(15.2)
Other family members	23	(2.6)	154	(17.9)
<b>Planning with husband for place of delivery</b>				
Yes	777	(86.0)	713	(82.6)
No	126	(14.0)	187	(14.7)
<b>Decision makers for delivery</b>				
Self	681	(75.4)	247	(27.4)
Others (MIL, Husband, FIL)	222	(24.6)	653	(72.6)
<b>Experienced any complications in pregnancy</b>				
Yes	235	(26.0)	552	(61.3)
No	668	(74.0)	348	(38.7)
<b>Experienced any complications during delivery</b>				
Yes	101	(11.2)	224	(24.9)
No	802	(88.8)	676	(75.1)
<b>Experienced any complications in PNC</b>				
Yes	136	(15.1)	417	(46.3)
No	767	(84.9)	483	(53.7)

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342 ANC= Antenatal care, FIL= Father-in-law, MIL= Mother-in-law, PNC= Post-natal care

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344 **Coverage of MNH services**

345 Fig. 1 presents the CoC completion rate by the district. In sum, 52% of the mothers in  
346 Dhading completed four ANC check-ups, whereas 36% did so in Nawalparasi. About 70% of  
347 the mothers in both districts gave birth in a health institution. The first PNC showed records  
348 similar to the statistics for institutional delivery in both districts. The CoC completion rate  
349 was 41% in Dhading and 28% in Nawalparasi. This outcome validates a significant  
350 difference between the districts (adjusted OR [aOR]: 1.75, 95% CI: 1.44–2.13). Still, the  
351 reception of additional PNC on the third and the seventh day after birth was reported for only



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3 352 6% of women in Dhading and 3% in Nawalparasi and varied considerably by district (aOR:  
4 353 1.95, 95% CI: 1.23-3.09).  
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8 355 **Factors associated with CoC completion rate**  
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10 356 The multi-variable analysis verified that the following factors were significantly different in  
11 357 at least one district: age, travel time to a health facility, wealth quintiles, parity, decision-  
12 358 makers for ANC, planning with husband to choose the place of delivery, and decision-makers  
13 359 concerning delivery. The associated factors for CoC completion rate varied by the district as  
14 360 shown in Table 2.  
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20 362 In Dhading, travel time to a birthing center and wealth quintiles were associated with the  
21 363 CoC completion rate. The mothers who required traveling time of 15 minutes or more to  
22 364 reach the birthing centers had poorer CoC completion rate, as compared to the mothers who  
23 365 had to walk for less than 15 minutes (aOR: 0.24, 95% CI: 0.08-0.76). CoC completion rate  
24 366 also was poorer among the mothers who travelled for more than 60 minutes' walk to reach to  
25 367 the birthing centers than the mothers who walk for less than 15 minutes (aOR: 0.51, 95% CI:  
26 368 0.30-0.86). Mothers in Dhading from the lower (aOR: 8.68, 95% CI: 3.27-23.05), middle  
27 369 (aOR: 3.50, 95% CI: 1.33-9.24), higher (aOR: 4.49, 95% CI: 1.96-10.30), and highest (aOR:  
28 370 2.40, 95% CI: 1.15-5.02) wealth quintiles were found with a higher CoC completion rate, as  
29 371 compared to the lowest.  
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39 373 On the other hand, in Nawalparasi, parity and decision-making for ANC, planning with  
40 374 husband, and decision-making for delivery were associated with the CoC completion rate. In  
41 375 Dhading, however, such associations did not show a notable impact on the CoC completion  
42 376 rate. The mothers having only one child had a better CoC completion rate than those having  
43 377 two children (aOR: 0.33, 95% CI: 0.13-0.83). Mothers who independently opted for ANC  
44 378 were more likely to have a better CoC completion rate than those who relied on the decision  
45 379 of family members (aOR: 0.29, 95% CI: 0.15-0.58). Aside from that, the mothers who  
46 380 planned the place of delivery with their husband had a better CoC completion rate than the  
47 381 ones planning alone (aOR: 0.38, 95% CI: 0.15-0.96). In Nawalparasi, it was observed that if  
48 382 the decision-makers for delivery were other family members, particularly the mothers-in-law,  
49 383 fathers-in-law, or husbands, the mothers were more likely to have higher CoC completion  
50 384 rate (aOR: 3.03, 95% CI: 1.52-6.06).  
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386 **Table 2. Multiple variable analysis of CoC (4th ANC visit, institutional delivery and 1st**  
 387 **PNC visit)**

Variables	Dhading (n=903) aOR (95% CI)	Nawalparasi (n=900) aOR (95% CI)
<b>Age group</b>		
Below 20 years	1.00	1.00
20-29 years	0.62 (0.20- 1.92)	4.38 (0.71-26.86)
Above 30 years	1.15 (0.50-2.64)	3.82 (0.97-15.05)
<b>Education</b>		
None	1.00	1.00
Primary/Lower Secondary	0.84 (0.33-2.11)	1.53 (0.51-4.57)
Secondary and above	1.19 (0.58-2.46)	1.54 (0.73-3.25)
<b>Ethnicity</b>		
Bramhin/Chhetri/Terai other caste	1.00	1.00
Dalit	0.67 (0.33-1.35)	2.29 (0.14-36.83)
Janjati/other caste	0.60 (0.28-1.32)	1.75 (0.13-24.66)
Muslim		1.75 (0.09-34.30)
<b>Religion</b>		
Hindu	1.00	1.00
Others	0.72 (0.39-1.34)	0.49 (0.04-5.81)
<b>Travel time to birthing center</b>		
Less than 15 minutes	1.00	1.00
15-60 minute	0.24 (0.08-0.76)*	0.62 (0.11-3.46)
More than 60 minutes	0.51 (0.30-0.86)*	1.53 (0.36-6.45)
<b>Wealth quintiles</b>		
Lowest	1.00	1.00
Lower	8.68 (3.27-23.05)***	1.21 (0.25-5.97)
Middle	3.50 (1.33-9.24)*	1.03 (0.22-4.87)
Higher	4.49 (1.96-10.30)***	0.82 (0.18-3.85)
Highest	2.40 (1.15-5.02)*	0.73 (0.15-3.60)
<b>Parity</b>		
One	1.00	1.00
Two	0.74 (0.37-1.49)	0.33 (0.13-0.83)*
Three or more	0.51 (0.25-1.02)	1.32 (0.60-2.89)
<b>Participated in health mothers' group meeting during pregnancy</b>		
Yes	1.00	1.00
No	0.80 (0.41-1.54)	1.29 (0.65-2.56)

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391 **Table 2.** (Continued)

Variables	Dhading (n=903) aOR (95% CI)	Nawalparasi (n=900) aOR (95% CI)
<b>Knowledge on 4 ANC check-ups</b>		
Yes	1.00	1.00
No	0.97 (0.47-2.02)	0.96 (0.38-2.42)
<b>Decision makers for ANC</b>		
Self	1.00	1.00
Others (MIL, Husband, FIL)	1.00 (0.48-2.05)	0.29 (0.15-0.58)***
<b>Planning with husband for choosing the place of delivery</b>		
Yes	1.00	1.00
No	2.36 (0.95-5.81)	0.38 (0.15-0.96)*
<b>Decision makers for delivery</b>		
Self	1.00	1.00
Others (MIL, Husband, FIL)	0.71 (0.38-1.34)	3.03 (1.52-6.06)**
<b>Experienced any complications in pregnancy</b>		
Yes	1.00	1.00
No	1.10 (0.61-2.01)	0.58 (0.30-1.11)
<b>Experienced any complications during delivery</b>		
Yes	1.00	1.00
No	0.56 (0.21-1.50)	0.51 (0.21-1.21)
<b>Experienced any complications in PNC</b>		
Yes	1.00	1.00
No	1.18 (0.51-2.71)	0.90 (0.44-1.82)

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393 ANC= Antenatal care, FIL= Father-in-law, MIL= Mother-in-law, PNC= Post-natal care

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395 \* p&lt;0.05

396 \*\* p&lt;0.01

397 \*\*\*p&lt;0.001

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399 **Discussion**

400 This study has two major findings. First, the CoC completion rate was different between two  
 401 districts: 41% in Dhading and 28% in Nawalparasi. Second, different associated factors were  
 402 detected for the CoC completion rate by districts. They were travel time to the health facility,  
 403 wealth quintiles, parity, decision-makers for choosing the place of ANC, planning with

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3 404 husband to choose the place of delivery, and decision-makers for delivery. Among them,  
4 405 traveling time to health facility and wealth quintile were associated with the CoC completion  
5 406 rate only in Dhading and the other factors were associated with it only in Nawalparasi.  
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10 408 In this study, the CoC completion rates in Dhading and Nawalparasi were 41% and 28%,  
11 409 respectively. This difference was seen in all the CoC measurement items. First, mothers  
12 410 receiving the four scheduled ANC check-ups that comply with the GoN recommendation in  
13 411 Dhading and Nawalparasi were recorded as 52% and 36%, respectively. This prevalence was  
14 412 lower than that of the NDHS in 2016; 68% in hills and 52% in Terai regions of Nepal.<sup>14, 15</sup>  
15 413 The difference can be explained by the place of birth in two regions. In this study, mothers  
16 414 delivering at the health institutions made up 78% and 68% in Dhading and Nawalparasi,  
17 415 respectively. According to NDHS 2016, this was 59% in the hill and 50% in the Terai  
18 416 regions.<sup>14</sup>  
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27 418 Receiving the first PNC within the first 24 hours of delivery was 78% in Dhading and 67% in  
28 419 Nawalparasi. The trends of institutional delivery and PNC 1 visit within 24 hours of birth  
29 420 were similar to that observed in NDHS 2016. The GoN recommends mothers and newborns  
30 421 to receive PNC three times within seven days of delivery, however, only 6% of mothers in  
31 422 Dhading and 3% in Nawalparasi were found completing PNC 3. It was quite low despite this  
32 423 intervention being a high priority program in Nepal.<sup>29</sup> It was much lower but similar to that  
33 424 reported in other studies.<sup>34, 35</sup> The prevalence reported in Cambodia was 5%, although the  
34 425 definition used there had been slightly different,<sup>34</sup> while in Ghana, it was only 8%.<sup>26, 36</sup>  
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43 427 In this study, the mothers in Nawalparasi were more dependent on their husbands, mothers-  
44 428 in-law, and fathers-in-law in choosing the place of ANC or delivery than in Dhading. About  
45 429 82% of the mothers in Dhading decided on ANC for themselves whereas only 53% did so in  
46 430 Nawalparasi. About 75% of the mothers in Dhading and 27% of them in Nawalparasi decided  
47 431 the place of delivery independently. In Nawalparasi, mothers were more likely to complete  
48 432 CoC if they decided the place of ANC themselves or planned the selection of the place of  
49 433 delivery with their husband or mother-in-law. Such associations were not significant with the  
50 434 CoC completion rate in Dhading. Hence, this study affirmed that the family members' role  
51 435 (i.e., mainly mothers-in-law) was prime in deciding the place of delivery in Nawalparasi. The  
52 436 mothers in Nawalparasi were less empowered, and therefore less involved in making  
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3 437 decisions. Other studies also explained that decision-making by the mother herself in  
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5 438 choosing a place of delivery is generally uncommon in rural Nepal.<sup>28, 35, 37-39</sup>  
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8 440 This study has three limitations. First, it covers only the perspective of the mothers, and not  
9 441 that of the health facility staff. Second, the participants represent only mothers from the rural  
10 442 areas of Nepal and the findings can be only generalized for rural women. Finally, as  
11 443 mentioned in the methods, the mountain region was not targeted in this study. This is because  
12 444 mothers live apart in there and obtaining sufficient numbers of data for statistical analysis is  
13 445 difficult.  
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### 20 447 **Conclusion**

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22 448 The CoC completion rate in MNH was low and different in two ecological regions: Dhading  
23 449 in hill region and Nawalparasi in Terai region. Major factors for the low rate were parity,  
24 450 travel time to a birthing center, wealth quintiles, spousal communication, decision-makers for  
25 451 ANC, and delivery. Travel time to a birthing center and wealth quintile were key factors for  
26 452 poor CoC in Dhading. However, family members' decision in seeking care for ANC and  
27 453 delivery was strongly associated with the CoC completion rate in Newalparasi. Differences in  
28 454 these factors may be reflected by geographic and socioeconomic conditions and the  
29 455 characteristics of household decision making in these regions. These findings will be useful  
30 456 to make tailor-made interventions to improve CoC in different regions.  
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40 458 This study also presented an alarming situation about PNC visits. As the second and third  
41 459 PNC visits were extremely low, we were obliged to use only PNC 1 to define CoC in this  
42 460 study. Mothers and families face barriers in seeking the second and third PNC as defined by  
43 461 government policy. Government policies might be revised based on the realities identified in  
44 462 this study, in particular, the timing of the second and third PNC check-ups. The findings of  
45 463 this study will be disseminated at local for promoting evidence-based planning to MNH.  
46 464 Home-based care by health workers is theoretically the way to go, but the lack of resources  
47 465 remains a challenge hindering any substantial progress. More studies need to be undertaken  
48 466 to improve the CoC completion rates in resource-limited settings.  
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13 474 **Authors' Contributions**

14 475 RCS and MJ conceived and designed the experiments, while AKP, AS, and RCS collectively  
15 476 analyzed the data. MJ wrote the paper along with RCS and AS, and the finalization and  
16 477 review of the entire manuscript were done by all the authors: RCS, AS, AKP, SI, and MJ.  
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21 479 **Data sharing**

22 480 Data is shared at figshare (10.6084/m9.figshare.14340128).  
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26 482 **Ethical approval**

27 483 Ethical approval for this study was obtained from the Research Ethics Committee of the  
28 484 Graduate School of Medicine, the University of Tokyo (Reference number 11204 dated 26<sup>th</sup>  
29 485 May, 2016). It was also obtained from the Nepal Health Research Council (Reference  
30 486 number 2125, dated 9<sup>th</sup> June, 2016).  
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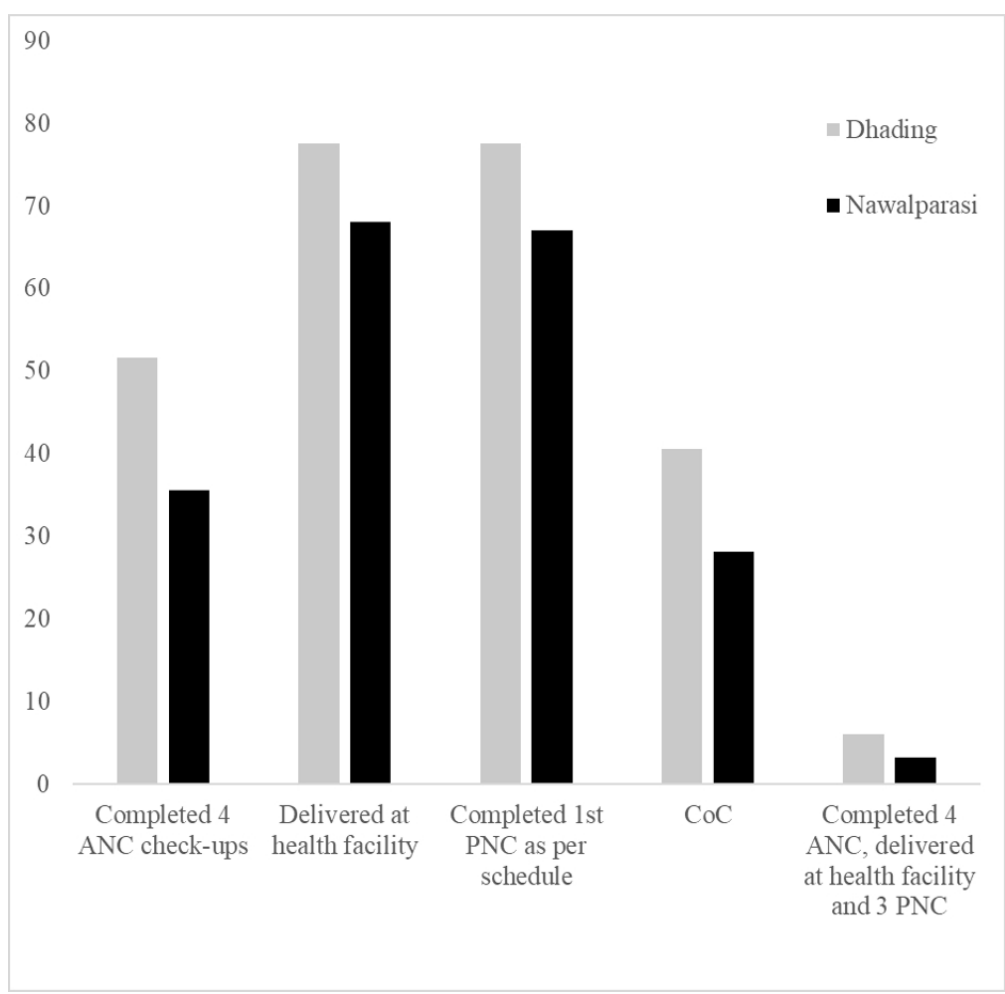


Fig 1. CoC completion rate by district (%) (n=1,803)

79x77mm (300 x 300 DPI)

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

	Item No	Recommendation	Page
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	10-11
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11
		(b) Describe any methods used to examine subgroups and interactions	n/a
		(c) Explain how missing data were addressed	n/a
		(d) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(e) Describe any sensitivity analyses	n/a
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12
		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	Report numbers of outcome events or summary measures	14-15
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear	15-16

		which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	n/a
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	17-18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	20-21
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

\*Give information separately for exposed and unexposed groups.

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