Supply environment and maternal health care in Nepal

Abstract

Though maternal mortality has been significantly reduced over the last decade, utilization of the maternal health services is not encouraging in Nepal. Inadequate supply of the maternal health services may be the reason of lower level of utilization; however, measure of the supply of maternal health services has received relatively less attention. Demographic and Health Survey data in Nepal can be used to understand pattern of the utilization, but it does not contain information on the health service supply environment. This study intended to fill this gap by exploring the association of health services supply environment with maternal health care controlling for individual and household characteristics. Two data sets, the Nepal Demographic and Health Survey, 2006 and a study on service supply environment conducted in 59 randomly selected clusters of the NDHS 2006 were linked and the association of supply environment on maternal health care were examined using multilevel logistic regression analysis among 938 women living in the 59 clusters of 13 districts. We found that,

- women living in rural areas and not having access to road were less likely to receive the maternal health services.
- availability of maternal and child health workers in the community increased the odds of receiving antenatal care
- presence of Nurse/Midwives in the cluster showed positive association with antenatal, delivery and postnatal care
- women with secondary or higher level of education were more likely to utilize maternal health services compared to their un-educated counterpart
- economic status of the household appeared to be the stronger predictor of maternal health care

Background

Safe motherhood program was initiated in 1997 with the objective of reducing maternal mortality in Nepal. It has brought significant improvement in maternal health by reducing maternal mortality to 281 per 100,000 live births in 2006. Uutilization of the maternal health services are however not encouraging. For example, as of 2006 Demographic and Health Survey, almost half of the pregnant women do not receive adequate antenatal care (four times), only about one fifth of the pregnant women deliver their baby with assistance from skilled health personnel and only about one third receive postnatal care (Ministry of Health and Population, New ERA, and ORC Macro, 2007).

Inadequate supply of the maternal health services may be the reason of the lower level of utilization, but the measure of the availability of maternal health services has received relatively less attention than that of measure of utilization in Nepalese literature. Demographic and Health Survey data in Nepal can be used to understand the utilization pattern, but it does not contain the information on maternal health service supply environment. This study intended to fill this gap by collecting in-depth information on the health service delivery environment in randomly selected NDHS clusters. Principal objectives of the study were to explore

the individual, household and community-level determinants of maternal health and to examine whether the health services supply environment is associated with the maternal health care controlling for individual and household characteristics.

Introduction

Previous studies have shown that the community characteristics are important determinants of individual health and health care behavior (Franzani, et al., 2005; Pebley, Goldman, & Rodriguez, 1996; Stephenson, et al, 2006; Stephenson & Tsui, 2003; Stephenson & Tsui, 2002). Stephenson et al. (2006) used percentage of women with high school education, percentage of women having previous delivery in health institutions, percentage of women whose husbands approve of family planning methods and number of children per women in the cluster as community-level indicators to examine their impact on maternal health care. They argued that cluster-level educational status influences institutional delivery through two possible mechanisms. Higher percentages of educated women in the communities are likely to be from communities with a higher percentage of economically advantaged households. Therefore, greater household wealth may enable women to seek care during pregnancy and delivery. Higher percentage of female education in the community may also point to greater awareness of the need for care during childbirth.

Franzani, et al. (2005) used the community impoverishment index to define the community structure and established association with self-reported health in the USA. The index was a composite score comprised of community poverty rate, unemployment rate, vacant housing rate, and proportion of households with children under the age of 5 with a single mother. Similarly, Stafford et al. (2004) also found that over and above individual factors, indicators of community deprivation (measured by proportion of single parent households, proportion of manual work, and unemployment rates) were associated with self-reported health in UK. Likewise, the ethnicity, economic status of families and the proportion of indigenous people in the community were associated with pregnancy related care in Guatemala (Pebley, Goldman, & Rodriguez, 1996).

Community indicators described above are aggregated from the individuals living in the communities. Such derived variables are criticized as having a compositional influence on health, and hence they are not contextual and the observed difference in health between places could be due to differences in the kinds of people who live in these places (Macintyre & Ellaway, 2003).

Availability of schools, industry, and grocery stores are other aspects of physical environment that have the potential to influence health outcome. Basically two mechanisms of influence of social and health infrastructure on morbidity and mortality are discussed; these include the preventive health behaviour and the medical risk factors (Franzani, et al., 2005; Sharma and Vong-EK, 2008). Physical distance of people to a health facility, cost of the medication and women's status are other two important factors affecting people's decisions to seek care. Availability of education and employment opportunity in the community can improve women's status; thereby improve maternal health through preventive health behaviour (Thaddeus & Maine, 1994).

Some of the previous studies indicated that community influences health outcome through access and availability of health infrastructure and health services (Midhet, Becker, & Berendes, 1998; Stephenson &

Tsui, 2002; Stephenson & Tsui, 2003). In India, the presence of a health facility in the community reduced the odds of reporting pregnancy and labour complications and increased the odds of contraceptive use and seeking treatment for sexually transmitted diseases (Stephenson & Tsui, 2002; 2003). Availability of health facility in the community was also found to vary across communities and was associated with self-rated health over and above individual characteristics in United States of America (Stafford, 2004).

Obstetric complications and related care seeking behaviour are also sensitive to quality of care in the health facility. The odds of postpartum haemorrhage, eclampsia, and sepsis were higher in communities with poor quality health services compared to the communities with better quality of health services in the United States (Guendelman, et al., 2005). Lack of transportation services and trained staff were the main reason reported for not seeking treatment for pregnancy-related complications and the utilization of maternal health services in Bangladesh (NIPORT, Mitra and Associates, and ORC Macro, 2001) and Pakistan (Midhet, Becker, & Berendes, 1998). Higher maternal mortality was also observed in communities with a lack of health personnel and poor transportation in Zimbabwe (Mbizvo, et.al., 1993) and India (Bhatia, 1993).

The presence of health facilities and staff pattern, provision of essential obstetric care, mean number of doctors per primary care facility, and percent of births at primary health care facilities have also been used as indicators for access and quality of health services in previous studies (Midhet, Becker, & Berendes, 1998; Bhatia, 1993; Guendelman, et al., 2005).

Promotion of increased access to family planning service was emphasized through different family planning movements during the 1970s and 1980s. Different studies carried out during the period to understand the relationship of service access to the contraceptive use suggested that the availability of contraceptive within communities were associated with increased rate of its utilization (Tsui, Hogan, Teachman, Welti-chanes, 1981; Seiber, E. & Bertrand, J.T. 2002).

After the International Conference on Population and Development (ICPD) in 1994, service providers and researchers focused increasingly on quality of services. A number of studies carried out to examine the relative importance of access to services versus perceived quality of care showed that the perceived quality was more important determinant of contraceptive use than distance or travel time (Bongaart and Bruce 1995; Mroz, Bollen, Speizer, and Mancini, 1999; Seiber, E. & Bertrand, J.T. 2002). Based on a study carried out in Malawi, Cohen, (2000) found that the mass media exposure, increased contraceptive choice, improved accessibility of services and improved service quality contributed to contraceptive use.

Only a limited number of studies were found to describe the effectiveness of health system input on health seeking behaviour and its outcome. Common problems found in such studies is an inadequate measurement due to the absence of longitudinal data on health system input and the community-level and its linkage to individual-level behaviour (Frankenberg & Thomas, 2001). Data from health information system at the local levels are mostly focused on the public sector and are of poor quality. Surveys of community-level health facilities can offer better measurement precision but are carried out irregularly. Linked community- and individual-level survey data systems on health service provision, awareness and consumption are thus rare (Tsui, A.O., Ukwuani, F., Gulikey, D. & Angeles, G., 2002).

Assessing the effects of health system-level inputs on population-level behaviours calls for hierarchically structured data and appropriate methods of analysis. Multilevel analysis methods offer techniques to construct a causal process with level-specific determinants that are connected through predictor or outcome variables. It allows one to trace the causal linkages hierarchically as to how health service access and quality can influence health status or personal response to treatment (Tsui, A.O., Ukwuani, F., Gulikey, D. & Angeles, G., 2002).

Women's access to antenatal care, delivery care, emergency care and family planning services was assessed using Service Availability Module (SAM) and women's questionnaire in 10 countries in Africa, Asia, Latin America and Caribbean. The report showed that the availability of maternal health services is consistently associated with greater use in every type of service considered. Rural women who live nearer to health services are not only more likely to seek antenatal care, but also use skilled attendant at delivery and use a modern method of contraception. The report also demonstrates that distance is a greater disincentive to seeking care at the time of delivery than at other times during pregnancy (Rose, M., Abdurrahman, N., Stanton, C. & Helsel, D., 2001).

Trained health personal at peripheral health facilities can help in the early recognition of danger signs and appropriate referral to a secondary care hospital. The presence of peripheral health services in the community can also provide primary care such as prenatal care (Midhet, Becker, & Berendes, 1998). Therefore, availability of a health facility and health personnel in the community can have a contextual influence on maternal health (LeBacq & Retsema, 1997).

The need to improve women's access to good quality maternal health services was one of the most important priorities set in the Safe Motherhood technical consultation held in Colombo in 1997. The challenge was however a need of tools to monitor the progress of Safe Motherhood Program. Service Availability Module (SAM) in Demographic and Health Survey has been developed as a tool to monitor the progress (Rose, M., Abderrahim, N., Stanton, C. & Helsel, D., 2001). We have applied the concept to examine the effectiveness of service supply environment on maternal health care in Nepal.

Methodology

We used the concept of Service Availability Module (SAM), to examine the association of cluster-level service supply environment in individual's health behaviour, which was introduced in Demographic and Health Survey (DHS). The DHS SAM has two components, a community-level survey and a facility survey. In the community survey, interviews are normally conducted with three to four knowledgeable residents from each DHS cluster, at least one of whom must be female. In facility survey, information is collected from health facility using check list and interview with health care providers. (Rose, M., Abderrahim, N., Stanton, C. & Helsel, D., 2001). Data from two surveys, the Nepal Demographic and Health Survey (NDHS) 2006 (women's data) and a separate study carried out on health service supply environment in the NDHS 2006 clusters were used for the analysis. Women's data of NDHS 2006 was linked with cluster-level information and association of cluster-level information on the odds of maternal health care were examined.

NDHS 2006 was designed to provide estimates of key indicators for the 13 domains obtained by cross-classifying the three ecological zones (Mountain, Hill and Terai) with the five development regions

(East, Central, West, Mid-west, and Far-west). We selected fifty-nine clusters randomly out of 260 to collect information on health service supply environment. These 59 clusters were selected in two stages; we first selected 13 districts randomly from 13 domains used in NDHS 2006 and then all the clusters from the randomly selected districts were considered as sampling unit for the community survey on health service supply environment. A structured questionnaire on health service supply environment was developed, pre-tested and interviewed in a group of key knowledgeable persons from sampled clusters was conducted (one of the key informants was Female Community Health Volunteer, FCHV). Two interviewers were selected and mobilized in each 13 districts according to their academic qualification and experience in field research. All the interviewers had at least bachelor degree education in health science related subject. Two days intensive training was provided to the interviewers before sending them in to the field. Data collection began immediately after the training. Fieldwork started in middle of May 2008, which lasted until middle of June 2008. Information collected from the community survey on health service supply environment was linked with NDHS 2006 individual data.

Cluster-level social characteristics, infrastructures and access of community based health services were considered as service supply environment. We asked a number of questions about availability of health facilities such as: hospitals, health centres, clinics, pharmacies in the cluster, availability of health personnel such as doctors, nurses, midwives etc. and a series of other questions to assess the geographical access to these facilities including distance, time to travel to facility from centre of cluster, and the types of services being provided in the health facilities.

We linked the cluster-level information of the 59 clusters the individual-level information of NDHS 2006. When we merged these two data sets, we obtained 983 women as the unit of the analysis of this study. The women eligible for this study were those who had at least one delivery during the three to five years period preceding the survey in 2006. Women's maternal health care behaviour was asked for the last pregnancy. Multilevel logistic regression analysis was used to examine the effects of health service supply environment on maternal health care (antenatal care, delivery care, postpartum care and timing of breast feeding).

Findings

Table 1 show the variables used in the analysis. Twelve variables were used to represent service supply environment, these include, type of road and transportation available in the cluster, distance of the cluster from nearest hospital and city, availability of health facilities and health personnel and the health facility's position in the cluster. We used a cumulative approach to multilevel model building. Model 1 included only individual factors. Model 2 included individual and household characteristics. Model 3 included the individual, household, and the variables representing service supply environment. Only the final model has been presented here for discussion. The random intercept terms are however presented for all three models in separate table. Table 2 shows the final model including individual, household and cluster-level variables to examine their association with five maternal health c are related variables. Table 3 shows the random intercept terms corresponding to the three different multilevel models of the five outcome variables.

Individual effects

Out of eight individual-level factors entered into the models, age was significantly related to antenatal care first visit only (Table 2). Older women were less likely to receive antenatal care than younger (age 35+ odds ratio = 0.35, SE = 0.16). Women's education was significantly associated with antenatal care first and fourth visit and delivery and postnatal care by health personnel. Women with educational level of secondary and above were more likely to receive antenatal care first visit (education secondary and above odds ratio = 3.52, SE = 1.73), antenatal care fourth visit (education secondary and above odds ratio = 2.29, SE = 0.73), seek delivery care (education secondary and above odds ratio = 1.78, SE = 0.63) and postnatal care by health personnel (education secondary and above odds ratio = 1.96, SE = 0.66) than those with no education. Similarly, women with education primary and above were more likely to receive antenatal care four visits (education primary, odds ratio = 1.73, SE = 0.40, education secondary and above, odds ratio = 2.29, SE = 0.73).

Ethnicity is an important factor which is known to determine care seeking behaviour. We found that the disadvantaged Janjatis were less likely to receive antenatal care first visit than the upper caste groups (Disadvantaged Janjatis odds ratio=0.53, S.E. = 0.15), similarly, Dalits were significantly less likely to receive delivery (Dalit's odds ratio = 0.42, SE = 0.15) and postnatal care (Dalit's odds ratio = 0.52, SE = 0.18) by trained health personnel than upper caste groups. Relatively advantaged Jannali's were however more likely to receive antenatal care fourth visit, delivery and postnatal care by health personnel than the upper caste groups. The association was highly significant for the uptake of antenatal care fourth visit (Relatively Advantaged Janjati's odds ratio = 2.65, SE = 1.15).

Exposure of family planning message reflects the woman's awareness of health campaigns in her community and an increased awareness is supposed to lead to a greater likelihood of recognizing and reporting health problems. We found that woman's exposure to newspaper at least once a week was associated with an increased odd of delivery (odds ratio = 2.25, SE = 0.70) and postnatal care (odds ratio = 2.06, SE = 0.62) by trained health personnel. An exposure woman with radio was significantly associated only with breast feeding within an hour of delivery (odds radio = 1.69, SE = 0.49). Woman's exposure with Television was however significantly associated with antenatal care first visit (exposure at least once a week, odds ratio = 2.94, SE = 1.50), exposure almost every day, odds ratio = 2.43, SE = 1.07), fourth visit (exposure at least once a week, odds ratio = 2.43, SE = 0.84; exposure almost every day, odds ratio = 1.92, SE = 0.60), delivery care (exposure at least once a week, odds ratio = 1.62, SE = 0.46) and postnatal care (exposure at least once a week, odds ratio = 1.75, SE = 0.44).

Women's final say on her own health care was found to be significantly associated with timing of breast feeding. Woman who can decide on her own health care jointly with husband (final say jointly with husband, odds ratio = 0.49, SE = 0.14) or someone else (someone else has final say, odds ratio = 0.56, SE = 0.16) were less likely to initiate breast feeding within an hour of delivery compared to the woman who can decide herself on her own health care.

Household-level effects

Household wealth quintile was used as a proxy to the socio-economic status of women. Women in the higher wealth quintile were significantly more likely to receive antenatal care first visit (highest wealth quintile, odds ratio = 18.30, SE = 12.9), antenatal care fourth visit (highest wealth quintile, odds ratio = 6.82, SE = 3.00) delivery care (highest wealth quintile, odds ratio = 2.86, SE = 1.37) and postnatal care (highest wealth quintile, odds ratio = 2.28, SE = 1.02) by trained health personnel than those in the lowest wealth quintile.

Place of residence was also significantly associated with the maternal and neonatal health care. Women living in the rural area were consistently associated with decreased odds of receiving antenatal care first (rural odds ratio = 0.45, SE = 0.20) and 4th visit (rural odds ratio = 0.47, SE = 0.19) delivery attendance by health personnel (rural odds ratio = 0.35, SE = 0.15), postnatal care (rural odds ratio = 0.61, SE = 0.24) and timing of breast feeding (rural odds ratio = 0.33, SE = 0.14).

Effect of supply environment

Unavailability of road in the cluster was associated with decreased odds of receiving antenatal care first visit (no road odds ratio = 0.33, SE = 0.14), antenatal care fourth visit (no road odds ratio = 0.22, SE = 0.08), delivery assistance by health personnel (no road odds ratio = 0.17, SE = 0.07) and postnatal care by health personnel (no road odds ratio = 0.25, SE = 0.10). Distance to the hospital is negatively associated with the antenatal care. Women living in the cluster which is farther from the hospital were significantly less likely to receive antenatal care first visit than women living nearer to the hospital (6-10 KM distance odds ratio = 0.43, SE = 0.19; 10+ KM distance odds ratio = 0.38, SE = 0.20). The presence of modern health facility in the cluster was associated with an increased odds of antenatal care fourth visit (odds ratio = 1.81, SE = 0.57).

Availability of Nurses or Midwives in the cluster were associated with an increased odds of antenatal care first visit (odds ratio = 2.51, SE = 1.13), antenatal care fourth visit (odds ratio = 2.31, SE = 0.94), delivery assisted by health personnel (odds ratio = 3.67, SE = 1.66), and postnatal care (odds ratio = 1.46, SE = 0.57). Availability of village health worker and maternal child health worker were associated with increased odds of receiving antenatal care first visit (odds ratio = 1.76, SE= 0.60) and timing of breast feeding (odds ratio = 1.38, SE = 0.47). Position of health facility in the cluster was also positively associated with the odds or maternal health care. Women living in the cluster where the perceived condition of health facilities are encouraging were more likely to receive antenatal care first visit (odds ratio = 2.76, SE = 1.04), antenatal care fourth visit (odds ratio = 1.48, SE = 0.45), attend delivery by health personnel (odds ratio = 1.19, SE = 0.42) and postnatal care (odds ratio = 2.14, SE = 0.69).

Random effect

Cluster-level random effect terms are shown in Table3. The size of the random effects change as the different explanatory variables added in the model. Model 1 includes only the individual factors and with the inclusion of the factors, significant cluster-level random effects were present for all the outcome variables. Significant cluster-level random effect remains with the inclusion of household-level factors in Model 2 for all

maternal and neonatal health care. Significant cluster-level variation remains un-explained even after inclusion of service supply factors in the Model 3. This result suggests that all the maternal and neonatal health care varied across the clusters. The magnitude of the cluster-level variation decreased with the inclusion of household and supply side variables in the Model, this further indicates that the variables included in the model are important.

Discussion

The result highlighted the individual-, household- and community-level influence on maternal health care and we found that the impact of these factors vary according to the outcome of the observation. The analysis included four aspects of the health service supply environment, the access to and availability of transportation, availability of health facility, availability of health personnel and the position of health facility in the community. All the community factors included in the analysis did not show their significant impact on the maternal health care.

Women living in the rural areas were less likely to be using all five types of maternal health services (antenatal, delivery and postpartum care by health personnel and breastfeeding within an hour of delivery). This may be due to the fact that rural areas are less accessible, and rural women live farther to health services and they have lesser choice of service provider than their urban counterparts (Rose, M. Et.al., 2001).

We also found that women living in the rural community lacking road facility and far from hospital were less likely to receive the maternal health services. The distance to the hospital was negatively associated with the antenatal care first visit but not with other maternal health care, suggesting the fact that even the access play some role it is not deciding factor for all maternal health care. The reason for this may be due to the quality of services. Women may be willing to pay in time and money for quality services. Similar result was found in a study conducted in Guatemala where a vast majority of family planning service users obtained the services from facility other than the one closer to their home because the facility had a good infrastructure, full time staff available to provide a full range of family planning services, counselling, educational talks, audio-visual materials and less restrictions for age (Seiber and Bertrand, 2000; Tsui and Ochoa, 1992). Therefore, maternal health program needs to improve quality of services, while maximizing the geographical availability of maternal health services to increase the utilization

Availability of trained health personnel in the cluster is another important factor determining the utilization of maternal health services. Government of Nepal has given priority to develop the skilled birth attendants (SBA) as a means to reduce maternal mortality to achieve millennium development goal (MDG). However, it takes long time and substantial financial resources to develop sufficient SBAs required to meet the national need. As an alternative, currently government of Nepal has mobilized nurse/midwives and maternal and child health workers in the primary health care facilities.

There appears a mix results from literatures on the association of health providers on the maternal health care. A study conducted in South Africa showed that presence of doctors at health facilities increased

the use of contraception. The presence of more community health workers however significantly reduced the adoption of pills over injectables (Stephenson, Beke and Tshibangu, 2007). Another study indicated that the availability of trained community-level family planning service provider increased the odds or family planning services in Uganda. It is suggested that provision of service provider in the community is associated with higher quality of services leading to greater adoption and lower discontinuation of contraceptive users (Katende, Gupta, and Bessinger, 2002). We found from this study that the availability of the maternal and child health workers in the cluster increased the odds of antenatal care and timing of breast feeding. Similarly, availability of Nurse/Midwives in the cluster increased the odds of delivery attended by health personnel. This finding suggests that the maternal health program intervention has been effective to increase the utilization of maternal health services. Availability of doctors and other health workers in the cluster however did not show significant association with maternal health care. That means community people may be more comfortable with midwives and maternal and child health workers for maternal health care than the other health workers.

It is also evident that increase in SBA and professionalization of delivery care is a key intervention to reduce maternal death in developing countries. But it is viewed that SBAs are helpless without the backing of drug, supplies and functioning health system, widespread access to these services is precondition for successful program and is closely associated with poverty (Zoe Matthews, 2002. Maternal Mortality and Poverty, DFID resource centre for social and reproductive health, UK)

Availability of health facility in the community is supposed to be another important determinant of maternal health care. This study did not show clear association of availability of health facility in the cluster with the maternal health care. This may be due to the poor quality of the service available in the facility. Lack of physical access to health facility, lack of awareness on the place of treatment, poor quality of health services and lack of female health providers were found as the significant barriers associated with health care for rural, uneducated, and less wealthy women in Bangladesh (NIPORT, Mitra and Associates and ORC Macro, 2001).

It is seen that the poor and vulnerable groups face many barriers to assess appropriate care. Rural and poor individuals are less likely than urban and wealthier counterpart to seek care from trained health care provider (Partners for Health Reform plus (PHRplus), 2004). We also found that the socioeconomic status of household measured by wealth quintile was the stronger predictor of maternal health care in Nepal. The reason for the low utilization of maternal health care by poor could be due to the financial barrier, inappropriate opening hours and lack of knowledge on the importance of health care. As income provides individuals and families necessary material resources and determines their purchasing power, a planned intervention to provide poor household an incentive of free or subsidized maternal health care could be a way to improve the maternal health care behaviour among the poor (Partners for Health Reform plus (PHRplus), 2004).

Prata, et.al. (2004) also suggests that poor socio-economic groups would experience the greater increase in service utilization if the maternal and neonatal health care were subsidized. In the face of scarce

resources, subsidy should be targeted according to socio-economic groups, in order to attain equitable and sustainable maternal health services. Improving economic status alone does not fully help to improve maternal health care, the health system should also be in the place that provide good quality facility-based delivery care as well as the availability of the skilled outreach workers (Zoe Matthews, 2002)

Apart from household wealth status, educational level of woman also has positive effect on the uptake of maternal health and delivery services. Levels of women's autonomy have also been linked with health care seeking behaviour at delivery. It also has strong effects on reproductive behaviour, contraceptive use, fertility, infant and child mortality, morbidity, and issues related to family health and hygiene (Frankenberg, et. al., 2001; Tsui, et. al., 2002). Consistent with this finding, we also found that the level of education of a woman was another important individual-level factor which increased the odds of maternal health care in Nepal. Increased knowledge, qualification and status through the occupation and income may be the pathway of its association with the maternal health care.

Recent study conducted in Bangladesh also indicated that use of maternal health care services differed according to women's educational level, wealth, and distance from hospital, religion and antenatal visit. Women from wealthiest quintile of household were more likely than those from the poorest quintile to have had skilled birth attendant, a caesarean delivery or postnatal visit. It was suggested that if maternal mortality is to be reduced, improving women's educational opportunities and reducing socioeconomic inequality should be viewed as central policy and program goal in the developing countries (Anwar, I, et.al. 2008).

Conclusion

Findings of this study indicate that the utilization of maternal health care varied across the clusters. A part of the cluster-level variation of maternal health care is explained by individual, household and supply factors. The health service supply factors could not explain fully the cluster-level variation, this highlight the need to collect other dimensions of supply environment. The significance and magnitude of impact of the supply factors also varied across maternal health care and some supply factors included in the analysis showed their significant association with maternal health care. Women who live in the rural area and who do not have access to road facility were less likely to receive the maternal health care. While availability of maternal and child health workers in the community increased the odds of receiving antenatal care, the presence of nurse/midwives in the cluster showed positive association with antenatal, delivery and postnatal care. Economic status of the household appeared to be the stronger predictor of maternal health care. Educational status was also found as an important individual-level actor to determine the maternal health care seeking behaviour of Nepalese women. Availability of maternal and child health worker and Nurse/Midwives in the cluster was significantly associated with increased use of maternal health care. Therefore there is a need to recruit locally the Nurse/Midwives in the community so as to increase the access of trained health personnel. Given the appropriate direction, the HFMC would also be able to recruit the MCHWs and ANMs to increase the access to trained health personnel. Government should formulate new policy so as to ensure the recruitment of health service providers from local community and ensure the availability and accessibility of

quality maternal health services in every corner of the community. To ensure the increased service utilization by poor socioeconomic groups, the maternal and neonatal health care should be provided free of cost. Improving women's educational opportunities and reducing socioeconomic inequality together with increased availability of quality maternal health services would help to improve maternal health in Nepal.

Acknowledgement

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Table 1- Variables Used in Modelling of Maternal Health Care: Nepal, 2008

Variables	Operational Definition	Range (Mean)
Individual-level variables		
Age	Age group of respondent	1-3 (2.1)
Education	Level of education of respondent	1-3 (1.5)
Occupation	Occupational status of respondent	1-4 (2.0)
Ethnicity	Ethnicity of respondent	1-5 (2.9)
Exposure of newspaper	Whether the respondent read news paper at least once a week	0-1 (0.2)
Exposure of radio	What is the frequency of listening to the radio	1-4 (1.7)
Exposure of television	What is the frequency of watching television	1-4 (1.1)
Final say on own health care	Who make decision for health care of respondent	1-4 (2.5)
Household-level variable		
Sex of household head	Whether the household head was male	0-1 (0.8)
Wealth quintile	Socio economic status of the household	1-5 (2.7)
Family planning worker's visit	Whether the household was visited by family planning worker's in the last 12 month	0-1 (0.2)
Place of residence	Whether the respondent's household is in rural area	0-1 (0.2)
Service supply environment		
Type of road	What type of road is available in the cluster	1-3 (2.1)
Distance to city	What is the distance of a cluster from the nearest city	1-3 (1.8)
Distance to hospital	What is the distance of a cluster from the nearest hospital	1-3 (1.8)
Availability of public transportation	Whether any kind of public transport is available in the cluster	0-1 (0.7)
Availability of health facility	Whether any kind of health facility is available in the cluster	0-1 (0.2)
Availability of PHCORC	Whether PHC outreach clinic is available in the cluster	0-1 (0.4)
Availability of pharmacy	Whether any pharmacy is available in the cluster	0-1 (0.4)
Availability of doctor	Whether any doctor is available in the cluster	0-1 (0.1)
Availability of nurse	Whether any nurse/midwife is available in the cluster	0-1 (0.1)
Availability of health assistants	Whether any HA or AHW is available in the cluster	0-1 (0.4)
Availability of VHW/MCHW	Whether any VHW or MCHW available in the cluster	0-1 (0.2)
Health facility position	Whether the health facilities available in the cluster are encourage, discourage or remain indifferent on the maternal health issues	0-2 (1.3)

Table 2- Multilevel Modelling of different maternal health care: Nepal, 2008

Parameters	Antenatal care first visit	Antenatal care fourth visit	Delivery attended	Postnatal care	Timing of breast feeding
Age					
< 20	reference	reference	reference	reference	reference
20-34	0.59 (0.24)	0.67 (0.22)	0.62 (0.22)	1.25 (0.44)	1.26 (0.38)
35+	0.35 (0.16)**	0.57 (0.24)	0.70 (0.32)	1.24 (0.55)	1.25 (0.46)
Education					
Illiterate	reference	reference	reference	reference	reference
Primary	1.39 (0.37)	1.73 (0.40)**	0.93 (0.26)	0.68 (0.18)	1.30 (0.30)
Secondary and above	3.52 (1.73)**	2.29 (0.73)**	1.78 (0.63)**	1.95 (0.64)**	1.51 (0.50)
Occupation					
Not working	reference	reference	reference	reference	reference
Agriculture self-employed	1.78 (0.66)	0.94 (0.27)	0.46 (0.14)**	0.76 (0.22)	0.64 (0.18)
Agriculture & manual	1.32 (0.56)	0.60 (0.23)	0.58 (0.24)	0.77 (0.29)	1.24 (0.45)
Service, clerical & sales	1.08 (0.70)	0.37 (0.16)**	0.98 (0.41)	0.89 (0.35)	1.39 (0.59)
Ethnicity					
Upper caste	reference	reference	reference	reference	reference
Rel. advantaged Janjatis	0.56 (0.27)	2.65 (1.15)**	1.15 (0.53)	1.53 (0.67)	1.25 (0.54)
Minority	1.22 (0.56)	0.84 (0.32)	0.40 (0.16)**	0.82 (0.31)	1.08 (0.39)
Disadvantaged Janjatis	0.53 (0.15)**	0.95 (0.24)	0.80 (0.22)	1.19 (0.30)	1.30 (0.31)
Dalit	0.74 (0.22)	0.84 (0.26)	0.42 (0.15)**	0.52 (0.18)*	0.80 (0.22)
Exposure of newspaper					
Not at all	reference	reference	reference	reference	reference
At least once a week	1.21 (0.51)	1.25 (0.37)	2.25 (0.70)**	2.06 (0.62)**	0.76 (0.23)
Exposure of radio					
Not at all	reference	reference	reference	reference	reference
Less than once a week	0.87 (0.28)	0.86 (0.31)	1.91 (0.88)	1.09 (0.38)	1.69 (0.49)*
At least once a week	1.12 (0.39)	0.92 (0.35)	1.87 (0.89)	0.77 (0.29)	1.41 (0.44)
Almost every day	1.17 (0.43)	1.08 (0.41)	2.40 (1.13)*	0.99 (0.38)	1.15 (0.37)
Exposure of television					
Not at all	reference	reference	reference	reference	reference
Less than once a week	1.14 (0.25)	1.45 (0.35)	1.62 (0.46)*	1.75 (0.44)**	1.37 (0.29)
At least once a week	2.94 (1.50)**	2.43 (0.84)**	1.72 (0.67)	1.57 (0.57)	1.47 (0.51)
Almost every day	2.43 (1.07)**	1.92 (0.60)**	1.71 (0.61)	1.56 (0.53)	1.47 (0.47)

Table 2- Multilevel Modelling of different maternal health care: Nepal, 2008, continued

Final say on own health care					
Respondent alone	reference	reference	reference	reference	reference
Respondent & husband	0.99 (0.31)	1.04 (0.31)	0.93 (0.32)	1.34 (0.40)	0.49 (0.14)**
Husband alone	1.04 (0.33)	0.76 (0.22)	0.98 (0.32)	0.97 (0.29)	0.64 (0.17)
Some one else	0.92 (0.29)	0.84 (0.25)	0.97 (0.33)	1.32 (0.41)	0.56 (0.16)**
Sex of household head					
Female	reference	reference	reference	reference	reference
Male	0.70 (0.19)	1.19 (0.30)	1.48 (0.42)	1.10 (0.28)	1.34 (0.30)
Wealth index					
Lowest	reference	reference	reference	reference	reference
Second	1.89 (0.51)**	1.42 (0.44)	1.08 (0.40)	1.10 (0.36)	0.87 (0.22)
Middle	3.11 (0.99)***	2.24 (0.74)**	1.36 (0.54)**	1.66 (0.59)*	1.47 (0.45)
Fourth	3.53 (1.27)***	3.30 (1.13)**	1.59 (0.64)**	1.40 (0.52)*	1.16 (0.36)
Highest	18.3 (12.9)***	6.82 (3.00)***	2.86 (1.37)**	2.28 (1.02)*	1.04 (0.44)
Family planning worker's visit					
No	reference	reference	reference	reference	reference
Yes	1.03 (0.26)	1.32 (0.30)	0.46 (0.13)**	0.73 (0.18)	0.99 (0.21)
Place of residence					
Urban	Reference	Reference	Reference	reference	reference
Rural	0.45 (0.20)*	0.47 (0.19)*	0.35 (0.15)**	0.61 (0.24)	0.33 (0.14)**
Type of road					
Paved	reference	reference	reference	reference	reference
Unpaved	0.81 (0.30)	0.44 (0.11)**	0.86 (0.24)	1.11 (0.29)	1.09 (0.34)
No road	0.33 (0.14)**	0.22 (0.08)***	0.17 (0.07)***	0.25 (1.10)**	1.28 (0.52)
Distance to nearest city					
0-10 KM	reference	reference	reference	reference	reference
10-50 KM	1.20 (0.55)	0.76 (0.30)	1.06 (0.48)	1.66 (0.67)**	0.61 (0.26)
50+ KM	1.27 (0.77)	0.63 (0.32)	1.11 (0.70)	0.89 (0.51)	0.89 (0.50)
Distance to nearest hospital					
0-5 KM	reference	reference	reference	reference	reference
6-10 KM	0.43 (0.19)*	1.71 (0.61)	0.45 (0.17)	0.47 (0.16)	0.52 (0.38)
10+ KM	0.38 (0.20)*	1.11 (0.49)	0.78 (0.39)	1.70 (0.28)	0.19 (0.45)
Availability of transport					
No	reference	reference	reference	reference	reference
Yes	1.59 (0.55)	0.06 (0.36)	1.07 (0.42)	1.07 (0.28)	0.82 (0.29)
Availability of health facility					
No	reference	reference	reference	reference	reference
Yes	0.95 (0.37)	1.81 (0.57)*	1.69 (0.58)	0.91 (0.28)	1.10 (0.38)

Table 2- Multilevel Modelling of different maternal health care: Nepal, 2008, continued

Availability of outreach clinic					
No	reference	reference	reference	reference	reference
Yes	0.83 (0.23)	0.79 (0.19)	0.86 (0.23)	1.00 (0.24)	0.66 (0.17)
Availability of pharmacy					
No	reference	reference	reference	reference	reference
Yes	0.93 (0.26)	1.39 (0.35)	0.80 (0.23)	0.79 (0.21)	0.90 (0.25)
Availability of doctor					
No	reference	reference	reference	reference	reference
Yes	0.61 (0.53)	0.91 (0.49)	0.597 (0.33)	0.99 (0.48)	1.45 (0.85)
Availability of nurse/midwife					
No	reference	reference	reference	reference	reference
Yes	2.51 (1.13)**	2.31 (0.94)**	3.67 (1.66)**	1.46 (0.57)*	1.82 (0.80)*
Availability of health assistant / Auxiliary health worker					
No	reference	reference	reference	reference	reference
Yes	0.75 (0.21)	1.11 (0.27)	0.95 (0.26)	1.11 (0.28)	1.01 (0.26)
Availability of Village health worker / maternal & child health worker					
No	reference	reference	reference	reference	reference
Yes	1.76 (0.60)**	0.87 (0.28)	1.00 (0.37)	0.66 (0.23)	1.38 (0.47)**
Position of health facility					
Discouraged	reference	reference	reference	reference	reference
Indifferent	2.36 (0.89)**	2.14 (0.69)**	1.13 (0.41)*	0.90 (0.30)	0.90 (0.34)
Encouraged	2.76 (1.04)***	1.48 (0.45)**	1.19 (0.42)*	2.14 (0.69)**	1.08 (0.37)

Note: Coefficients are presented in odds ratio (with standard errors in parenthesis), *** Significant at P=0.001, **Significant at P=0.05, * Significant at P=0.10

Table 3 Random intercept terms for modelling of five maternal health care outcomes, Nepal, 2008

Maternal Health Care	Model 1 Random effect (SE)	Model 2 Random effect (SE)	Model 3 Random effect (SE)
Antenatal care first visit	1.11 (0.33)	0.51 (0.21)	0.25 (0.12)
Antenatal care fourth visit	0.48 (0.19)	0.28 (0.14)	0.14 (0.08)
Delivery care by health personnel	0.30 (0.18)	0.14 (0.14)	0.12 (0.07)
Postnatal care by health personnel	0.51 (0.22)	0.36 (0.18)	0.11 (0.06)
Timing o breast feeding	0.83 (0.26)	0.45 (0.17)	0.23 (0.12)